CHANGES IN THE UPPER LIMIT OF CULTIVATION

IN SOUTH-EAST SCOTLAND :

1600-1900

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Doctor of Philosophy

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December 1972

TO C.J.P.

ABSTRACT

This study considers those changes which have occurred in the upper limit of cultivation over the period 1600-1900 in the Lammermuir Hills of south-east Scotland. It sets out to map, date and explain these changes and, in particular, the occurrence of long-abandoned land at high levels. In pursuing these aims the study tests three hypotheses: that the limit of cultivation has retreated markedly since 1600; that this retreat represents the abandonment of long-term, not ephemeral cultivation; that change in the limit of cultivation may be taken as an indicator of change in agricultural prosperity.

Consideration is first given to recent changes in the limit in order to define a 'moorland core' that has lain unimproved since at least 1860. A survey of this core both in the field and from aerial photographs revealed that more than one-tenth of it had once been cultivated at some period before 1860. Moreover, the analysis of early maps pointed to the sites of many abandoned farm steadings, which had been associated with the former cultivation.

The reclamation and abandonment of this land was dated by reference to the morphology of cultivation ridges, a sequence of early maps and miscellaneous estate plans and manuscripts. This enabled the advance and retreat of the limit of cultivation to be traced, the conclusion being that retreat was characteristic of the late seventeenth century, the 1770s and the period 1819-23. Periods of marked advance were 1760-70, 1780-1816 and 1858-77.

The explanation for these changes is sought in a combination of physical and socio-economic factors. Secular deterioration of climate is suggested as an underlying cause of high-level abandonment before 1750, but more recent stimuli for change were probably technical innovation and fluctuation of prices.

The survey enables the verification of the first two hypotheses but demands that the third be refuted. Its main contribution lies in the further understanding of, first, the history of agriculture in upland Britain, secondly, the significance of secular climatic change and, finally, the extent of abandoned upland that might be reclaimed with profit in the future.

DECLARATION

This thesis has been composed by the undersigned and is based on his own research

M.L. Parry

12 December, 1972

ACKNOWLEDGEMENTS

The research for this thesis would not have been completed without the assistance of the following:

Mr A.W. Brotchie	Air photographs Library, Scottish Development Department
Mr J.G. Cullen	Deputy Chief Surveyor, Department of Agriculture and Fisheries for Scotland
Dr R.A. Dodgshon	Department of Geography, University College of Aberystwyth
Mr J.A. Edwards	Archivist, Reading University Library
Mr D. Ray	Edinburgh and South of Scotland School of Agriculture
Mr E. Renshaw	Department of Statistics, University of Edinburgh
Mrs L. Timperley	Scottish Record Office

In particular, I am grateful to the farmers of the Lammermuir Hills whose ready assistance enabled the mapping of the study area and whose continuing interest in the results was a great encouragement to me in the analysis of the data.

I am indebted to Mr Michael Robson, School of Scottish Studies, who made a number of suggestions concerning parallel trends in Selkirkshire; and to Mr Alexander Fenton, National Museum of Antiquities of Scotland, who offered many helpful suggestions in the early stages of the research and who commented on the drafts of Chapters 4 and 5. Moreover, Professors H.H. Lamb and Gordon Manley made a number of comments on Chapters 9 and 10 that have been incorporated in the final draft.

To Professor J.T. Coppock and Dr I.H. Adams in the Department of Geography at Edinburgh I wish to express my thanks. They supervised the work from its inception and made numerous suggestions for the editing of the drafts. Their encouragement, and that from fellow-postgraduates, was especially welcome. I am also grateful to Mr Alec Bradley and Mr Ray Harris, who drew the maps, and to Mrs Mary Young, who typed the final draft with great competence.

Finally, I would like to acknowledge the unfailing encouragement and assistance offered by my wife; this thesis is offered to her in return.

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LIST OF ABBREVIATIONS

a/p	aerial photographs
BM	British Museum
D.A.F.S.	Department of Agriculture and Fisheries for Scotland
GD	Gifts and Deposits held in the Scottish Record Office
GR	Grid reference
MAFF	Ministry of Agriculture, Fisheries and Food
NLS	National Library of Scotland
NRA(S)	National Register of Archives (Scotland)
NSA	The new statistical account of Scotland, by the ministers of the respective parishes, 15 vols., Edinburgh, 1845
OSA	Statistical account of Scotland, edited by Sir John Sinclair, 21 vols., Edinburgh, 1791-99
PWD	Potential water deficit
PWS	Potential water surplus
RAF	Royal Air Force
RCHM(S)	Royal Commission for Ancient and Historical Monuments (Scotland)
RHP	'Register House Plan' held in the Scottish Record Office
RUL	Reading University Library
SDD	Scottish Development Department
SRO	Scottish Record Office
T.H.A.S.	Transactions of the Royal Highland and Agricultural Society
UNESCO	United Nations Educational and Scientific Organisation

SYSTEM OF REFERENCING

Grid references: All references refer to the National Grid sub-region NT, unless otherwise stated. Grid references are, in general, given only at the first mention of a site.

Published references: The Harvard system is used. Page numbers are given in the text only when the reference is to a book or a quotation.

References to aerial photographs: These are prefixed by the abbreviation a/p, followed by the flight number, flight line and print numbers.
Thus:

a/p: 58/RAF/3262: F65: 0188-9

All the photographs are held in the Air Photographs Library, Scottish Development Department, and were flown by the Royal Air Force.

References to manuscript estate plans: These are presented as follows: institution at which plan is held; reference number (if any); name of site to which plan refers; date.
Thus:

RHP 3350: Chirnside Common, 1805

(N.B. SRO is omitted if plan is designated RHP)

References to other manuscripts: These are presented as follows: institution at which manuscript is held; reference number (if any); brief title of manuscript; date.
Thus:

RUL, BERW 1/2/1: Marchmont Labour Book, 1746-50

(N.B. SRO is omitted if manuscript is designated GD)

Order of references: Where more than one type of reference is given, these are presented in the following order: grid reference; estate plan or manuscript; aerial photographs.

PART I

INTRODUCTION

CHAPTER 1

THE PROBLEM AND THE APPROACH

The slopes of hill areas throughout Great Britain are traversed by a boundary between unreclaimed moor and improved farmland. On the landscape this boundary is often distinct, as in the contrast between the subdued tones of upland heather and sedge, and the bright green of sown grasses. Elsewhere it may comprise a more gradual change from degraded pasture invaded by sedge and bracken to closely grazed natural grassland. In either case, the boundary is readily distinguished. It is the movement of this boundary that is the subject of this thesis.

This limit of improved land is a visible expression of the balance between the economic and social pressures for an extension of farmland (or its diminution) and the physical restraints on cultivation which increase with elevation. Other indicators of this balance, such as the upper margin of certain patterns of cropping or of certain intensities of stock rearing, do exist but, since they are not clearly manifested on the landscape, they are less easily mapped.

THE SIGNIFICANCE OF THE LIMIT OF CULTIVATION

Historical significance

Owing to its ease of recognition the limit of cultivation is thus a convenient indicator of an agricultural frontier, and it is plausible to suggest that in Great Britain, where the settlement and cultivation of upland margins go back several centuries, cumulative experience has adjusted the location of the limit to natural conditions (Coppock, 1963). Yet even the most cursory glance at the present landscape will suggest that the limit has not been stationary. Indeed, at the local scale there is frequent change in its location.

In the period of earliest colonisation this change in the limit of cultivation is likely to have been the product of inadequate adjustment to natural conditions - to trial and error by upland farmers. But in more recent times the scale of change is probably due to other forces. In particular, it is clear that changes in land use are often a response to changes in agricultural prosperity and that they are most marked on land of intermediate quality, the best and poorest land showing greatest stability (Coppock, 1963). Mediocre land near the margin of the improved area is thus reclaimed and abandoned according to economic, social or political forces that determine levels of prosperity in agriculture; and, since the limit of cultivation is the product of such reclamation and reversion, its location reflects the operation of these forces.

Movements of the limit of cultivation, up and down the hillside, may thus be viewed as a sensitive indicator of changing incentives for reclamation in the face of physical, mainly climatic, restraint. Its sensitivity to such changes has been tested by Chapman (1961) in the North York Moors, and has been observed by Moisley (1964) in the Scottish Highlands.

It is clear, then, that by mapping and dating movements of the limit it is possible to detect trends in the history of the rural economy. This is of especial value in upland areas to which the trends would, of course, most closely relate, since it is in these areas that economic history is poorly documented. Indeed, throughout Scotland, which is characterised by a scant manuscript record before the mid-seventeenth century, a study of cultivation limits may be particularly valuable.

Agricultural significance

Since the peripheral zone of reclamation and reversion is indicacative of land that was marginal to cultivation at a particular time, changes in the limit of cultivation also point to levels of land capability (Coppock, 1963). Around the Pentland Hills in Midlothian, Geddes (1951) has thus identified 'debatable lands' which have fluctuated between moorland and cultivation since the sixteenth century.

Of more specific value is the classification of land in terms of its past use to aid decisions on modern improvement. In Cornwall, Hilton (1953) has classified land according to the length of time in which it has been cultivated or lain unimproved since A.D. 1485 in an attempt to help farmers avoid most pitfalls in future reclamation.

Furthermore, a knowledge of the distribution of former cultivation would point to areas that might profitably be reclaimed. In Scotland the need for reclamation was emphasised in 1957 by the Natural Resources (Technical) Committee, and in its south-eastern counties in particular by a regional plan which recommended the intake of derelict land (Mears, 1948: 35-6). A prerequisite for the rehabilitation of abandoned areas is clearly their mapping and, moreover, an assessment of the period over which they were productive. Some of the uplands in Great Britain which were formerly cultivated may have been so only for one or two years in response to local and ephemeral incentives or to a misjudgement by farmers. There is little reason to suppose that these are worth reclaiming. Yet former arable may hold specific advantages for cultivation. For example, in 1970 in Glen Esk (Angus) it was found that farmers wishing to extend their improved land were consulting records that would point to areas cleared of stones for intake in the prosperous years of the 1870s but abandoned soon after 1880. They were unable to identify these sites in the field.

Similar intake of long-abandoned land has been reported elsewhere in Scotland and is expected to continue in the immediate future in response to government subsidies and to market forces (Scottish Farmer, 12.2.72: 24). Entry into the European Economic Community may remove some of these economic incentives (Ray, 1971a: 42; 1971b), but continued reclamation might be fostered as a social provision in the Scottish Highlands. Moreover, the classification of land capability in the region, which has been proposed on ecological grounds, would benefit from a knowledge of abandoned cultivation (McVean and Lockie, 1969: 109).

Changes in the limit of cultivation are therefore both a mirror of regional economic and social change, and an aid to land reclamation. Yet their value both to the economic historian and to the farmer is severely limited, first, by an ignorance of their chronology, particularly of the quantity and location of former cultivation and of the date of its abandonment and, secondly - at the same time a product and a cause of the first - by the lack of an adequate technique for their mapping and dating. These problems will be considered in turn.

Existing chronologies of the limit of cultivation

It will be demonstrated later that changes in the limit of cultivation may be interpreted from a comparison of the several editions of Ordnance Survey maps. Prior to the first edition of these maps, which was surveyed in the 1850s and 1860s in England and Scotland, the construction of a chronology rests on the analysis of diverse and inadequate data. As a result few studies of early limits of cultivation have been attempted.

Scotland

It is indicative of the state of historical research in Scotland that little work has been published on the reclamation or abandonment of land in the region.

In a pioneer study Robertson (1949) examined the location of the head-dyke, a stone and turf wall dating often from before the eighteenth century and designed to keep hill cattle and sheep from cultivated ground. In those areas where it can be traced it marks the limit of cultivation of that period preceding the disappearance of the infield-outfield system. Robertson, however, assumed the head-dyke to follow the moorland edge on the third edition of one-inch Ordnance Survey maps, with consequent prejudice to her results.

Lebon (1946a), MacSween (1959a) and Gailey (1961) have made reference to the retreat of cultivation in western Scotland since the early eighteenth century, but their work is focussed on change in settlement and attention to the limit of farmland is secondary. MacSween and Gailey agree that in both Skye and the south-west mainland the maximum extent of cultivation was reached in 1750-80, and that thereafter there occurred a contraction of tillage and an abandonment of upland settlement (MacSween, 1959a: 46; Gailey, 1961: 152). Lebon (1952), however, contends that in Ayrshire the limits of settlement and tillage have remained largely unchanged since 1600; and in Midlothian Geddes (1960) has suggested that an upward advance of cultivation may have begun as early as 1740. These chronologies are based on scattered and indirect sources, and it is likely that the disagreement between them is due as much to errors of conclusion as to regional disparity.

England and Wales

An earlier interest in the study of upland cultivation was shown in England and Wales. But the pioneer works, such as those by Orwin on Exmoor (1929) and M'Caw (1936) on the Black Mountains, tended to concentrate on recent trends for which more data are available. That by Hoskins on Dartmoor was the first to consider the advance and retreat of tillage, and the creation and abandonment of farms, over the entire period since Domesday (Hoskins and Finberg, 1952: 289-333).

It presents a picture of widespread colonisation in the twelfth and thirteenth centuries up to 365 m O.D. with subsequent retreat, or at least a cessation of advance, after the Black Death. From A.D. 1550 the creation of new farms suggests renewed advance and the steady improvement of moor up to the first of the parliamentary enclosures in 1810.

The value of more recent studies has been enhanced by consideration of the location of the frontier of cultivation, increased emphasis being given to the distribution of reclamation rather than to its chronology. In the Derbyshire Pennines Eyre (1954) illustrated the pattern of intake from the twelfth to the nineteenth centuries, emphasising the physical factors which determined the location of land improvement; and in Wharfedale Crossley (1954) discussed the processes of early reclamation. Both distinguish between widespread assarting in the medieval era, piecemeal and often illegal 'intaking' after 1550, and parliamentary enclosure from 1780.

Shorter periods of advance have been examined in the Mendip Hills (Williams, 1971) and the Staffordshire moorlands (Sturgess, 1961), and the reclamation of waste land over 1780-1880 in England and Wales has been summarised by Williams (1970). From these and other works one may postulate the slowing of advance in the late medieval period, an interim period of minor change, and a rapid extension of cultivation from the late eighteenth century.

Yet, apart from the work of M'Caw, the focus of discussion in these studies has been solely the advance of improvement. If mention is made of temporary retreat, or even permanent abandonment, the reversion is neither dated nor mapped. The chronology is consequently incomplete. This is unfortunate for there is substantial evidence for cessation of reclamation and abandonment of land both in the late medieval era (Baker, 1966; Beresford, 1951, 1969; Beresford and St Joseph, 1958; Jones, 1965; Thomas, 1972), in the mid-eighteenth century (Lebon, 1946a; MacSween, 1959a; Gailey, 1961), and after the Napoleonic Wars (John, 1967).

The only work to consider reversion in a chronology of long-term change at the edge of cultivation has been by Chapman (1961) in an examination of the moorland edge in the North York Moors. This illustrated the complexities in the pattern of intake and abandonment, and enabled a comprehensive chronology to be compared with concurrent changes in the regional economy. The study concentrates on the period following 1750 and for evidence of abandonment relies heavily on Ordnance Survey maps, but the hypothesis of reversed fluctuation at the moorland edge rather than mere change in pace of advance represents a new approach.

Ireland

In Ireland students of land-use change have focussed on widespread reclamation in 1780-1840 (Connell, 1950), or on abandonment that followed the Great Famine (Finch, 1953). The emphasis has been on a chronology of change or the factors which affected it, in spite of an inadequate knowledge of its location and extent.

The problem may be summarised, then, as one of ignorance of former changes in the limit of cultivation, which has prohibited an assessment of their importance to economic history or to contemporary agriculture. This ignorance is a product, first, of concentration on local and unique rather than on synoptic movements that may be indicative of regional economic change (Coppock, 1963). Secondly, it arises from an emphasis on the date or chronology of the movements to the exclusion of their mapping and their measurement.

The quantity and date of abandoned land

A specific part of the foregoing problem is the quantity of abandoned cultivation in the uplands, its date of abandonment and its explanation. The evidence for abandonment is abundant on the relict upland landscape and its casual observation is frequently reported in connection with ecological and historical studies (Fenton, 1951a; Robertson, 1949). There have, however, been few attempts to assess its timing or to record its distribution.

In Scotland it is known to be widespread (Moisley, 1964), and in different regions has been dated to the late medieval era, to the plagues of the 1640s, and to the second half of the eighteenth century (Geddes, 1951; McKerral, 1948: 78; Gailey, 1962). With the exception of Ardnamurchan (Argyllshire) little is known of its location (Gailey, 1963).

In England former cultivation has been most frequently remarked upon in connection with deserted medieval villages (Beresford, 1951; Beresford and St Joseph, 1958: 98; Beresford, 1971: 7), although detailed examination has been made of apparent contraction of arable in the early fourteenth century (Baker, 1966). The suggestion is that most abandoned land in the uplands dates from the mid-fourteenth century or from the post-Napoleonic depression. This is generally supported by studies in Wales and in West Germany (Thomas, 1972; Scharlau, 1958), although discordant chronologies in Ireland and Sweden suggest strong regional differences in northern and western Europe (Proudfoot, 1960; Aalen, 1962; Aldskogius, 1960).

While there is evidence, therefore, for the widespread existence of former upland cultivation, its distribution and its extent, particularly in northern parts of Great Britain, are unrecorded. It is suggested that this has contributed to inadequate dating which, in turn, has precluded satisfactory explanation for the initial intake and subsequent abandonment.

Absence of an established methodology

Ignorance of the nature and extent of former cultivation is due largely to the shortcomings of techniques previously used in the mapping and dating of abandoned land. Hilton (1953) and Crossley (1954) incorporated field survey and the study of field names into the traditional documentary approach, and to this Eyre (1954) added the survey of field shape. Gailey (1961) and, more recently, Glassock (1970) have used aerial photographs to map deserted farmsteads and villages, but not abandoned land.

The mapping of former limits of cultivation has thus depended, first, on observation in the field, a technique with serious drawbacks in areas of rough moorland, and, secondly, on a documentary record which is rarely comprehensive in time or in space. Consequent errors, especially omissions, in the mapping have prejudiced the dating and explanation of changes in the limit of cultivation.

AIM OF THE STUDY

This study attempts to solve those problems outlined above. It aims:

1. To establish a technique of mapping and dating with accuracy the reclamation and reversion of land at the upper limit of cultivation. The comprehensive measurement and timing of such changes is a prerequisite of their explanation.

2. To map, measure and date the reclamation and reversion of land in a selected area.

3. To trace synoptic movements of the upper limit of cultivation in the area.

4. To explain these movements.

HYPOTHESES

In pursuing these aims the study will test the hypotheses:

1. That there is a large quantity of unmapped and undated abandoned farmland in a selected area of upland Scotland.

2. That this land represents former long-term, not ephemeral, cultivation and its abandonment is therefore important to the economic history of the region and its present land capability.

3. That the fluctuations of a cultivation limit, of which this abandonment is a part, are largely the product of economic forces and are therefore convenient indicators of changing prosperity in agriculture.

CHOICE OF THE STUDY AREA

It has been suggested that the study of limits of cultivation may be of especial value in those regions where economic history is poorly recorded by documentary sources; and there is, *prima facie*, evidence to suggest this is particularly true for upland Scotland since the paucity of the written record is a major hindrance to historical research in the region and casual observation has revealed extensive abandonment that is likely to reward examination.

The Lammermuir Hills in south-east Scotland offer particular advantages as a laboratory in which to study trends that might be common elsewhere in the region and to establish a methodology that might be applied in the Scottish Highlands. These are summarised below:

1. Cereal cultivation in these hills has always been an important activity and is likely to reflect closely changes in agricultural prosperity.

2. The area has a more comprehensive coverage of both early estate plans and aerial photographs than most other parts of Scotland.

3. It lies between the Lothian plain and the Berwickshire Merse, the traditional foci of agricultural innovation in Scotland. It may therefore reflect the impact of technical innovation in agriculture on the upper limit of cultivation.

4. The area is characterised by gentle slopes and low elevation which allow the limit of cultivation to fluctuate over a wide area in response to social or economic stimuli. This is important for in maritime climates the rapid loss of growth potential with elevation ensures that the quantity of fluctuation is strongly affected by angle of slope (infra p. 286).

5. A reconnaissance survey indicated that abandoned land was extensive in the area.

DEFINITIONS

The limit of improved land may be defined in a number of ways, according to the degree of improvement adopted as the criterion. Eyre (1954: 4) studied the upper limit of small fields, stressing that the cost of enclosing land was likely to reflect its intensive use, and that this limit might be readily observed in the field.

Yet in Scotland, where the agricultural revolution was long-delayed, enclosure tended to spread outwards and upwards in the eighteenth century from focal points of innovation, its rate of advance being determined by regional or national, rather than local, incentives for improvement. The advance of enclosure was, therefore, no reflection of an advance of tillage and the limits of small fields did not indicate the upper margin of farmland. Indeed, in the most remote upland areas, it was not until 1880 that the limit of enclosure corresponded to the limit of improved land.

A more convenient frontier for study is the limit of cultivation, the upward margin of land that has been reclaimed by ploughing and is sown with crops or grass. This definition includes long leys of grass but excludes hill pastures reclaimed by surface seeding and controlled grazing of moorland. The distinction is thus made between land that has, or has not, been ploughed, the reason for this being that the only technique for comprehensively mapping abandoned farmland is the survey of cultivation ridges. The site of hill pastures that were at one time partially improved but were not ploughed and sown, can be detected only with difficulty on the relict landscape.

The term 'moorland edge' includes unploughed but improved land and is used only in reference to the edge of improvement located by the Ordnance Survey, which takes account only of type of vegetation in its classification of land (infra p.32).

OUTLINE OF APPROACH

This study will examine synoptic changes in the upper limit of cultivation that have occurred in the Lammermuir Hills and Stow Uplands in south-east Scotland over the preceding three and a half centuries. The survey adopts as its base-line the beginning of the seventeenth century since there are extant from this date documents that contain data of immediate relevance to the limit of cultivation. The history of Scotland up to this period has been inadequately researched and, until such time as this is remedied, there will remain too limited a comprehension of economic change upon which to develop studies of a more specific nature.

The presentation of this survey is organised as a report on three operations: the mapping of changes in the upper limit of cultivation, the dating of these changes and, finally, their explanation.

In the introductory chapters the physical characteristics and agriculture of the study area are discussed in brief. The present limit of cultivation is examined and recent changes in this limit are observed.

In Part II the mapping of earlier changes in the limit is discussed. This is directed toward an accurate assessment of their quantity and location. A technique for interpreting relict features of former cultivation from aerial photographs is established, and former limits plotted by this method are compared with evidence from a selection of county maps.

In Part III the dates of changes in the limits are established by reference to evidence on the relict landscape, on county maps and in a variety of documents.

In Part IV an explanation of these changes is sought, firstly, in an adjustment of the physical determinants of the cultivation limit and, secondly, in a variety of social, economic and political trends.

CHAPTER 2

THE STUDY AREA

The area selected for study extends into five Scottish counties: Midlothian, East Lothian, Berwickshire, Roxburghshire and Selkirkshire (Fig. 2.1). It embraces 24 parishes that cover the Lammermuir Hills and their lower slopes in the upper Merse and on the Haddington plain. Parishes are a convenient unit of delimitation for their boundaries often coincided with the marches of early estates and they are used as units for the collection of agricultural returns.

The Stow Uplands, which lie on the south-western flank of the Lammermuirs, are included in the study area both to complete the physical unity of the region and to incorporate an area that is characterised by high levels of cultivation. These uplands, however, are not conveniently delimited by parish boundaries. The western edge of the study area is therefore drawn along the River Tweed, the Gala Water and, in the north, along the headwaters of the River Tyne.

The region is delineated in Figure 2.1. It covers 131,332 ha (324,534 acres), includes a population of about 16,340 and comprises about 550 holdings (Table 2.1). Forming the north-eastern extremity of the Southern Uplands and flanked by the Lothian plain and the Berwickshire Merse, it has an obvious physical unity that has promoted a common history.

Table 2.1

The study area: extent, population and number of holdings

parish	area (ha)	no.holdings[1] (1969)	population (1961)
EAST LOTHIAN			
Garvald and Bara	5,426	15	374
Humbie	3,550	18	399
Innerwick	5,316	39	484
Oldhamstocks	2,994	13	221
Spott	3,168	10	226
Stenton	3,047	9	352
Whittingehame	6,259	18	300
Yester	3,654	21	744
BERWICKSHIRE			
Abbey St Bathans	2,365	6	125
Bunkle and Preston	3,711	14	c.500
Channelkirk	5,745	22	343
Cockburnspath	5,160	19	635
Coldingham	10,265	82	2,031
Cranshaws	2,446	5	98
Duns	4,615	35	2,495
Gordon	3,934	20	643
Greenlaw	4,920	26	777
Langton	2,890	11	307
Lauder	13,604	55	975
Legerwood	3,552	16	257
Longformacus	8,526	13	240
Polwarth	1,214	4	94
Westruther	5,934	25	316
MIDLOTHIAN			
Crichton (part of)	2,125	(c.10)	(c.1,099)
Fala and Soutra	2,662	12	175
Heriot (part of)	700	(c. 3)	(c. 30)
Stow (part of)	4,478	(c. 6)	(c.900)
ROXBURGHSHIRE			
Melrose (part of)	8,832	(c.25)	(c.600)
SELKIRKSHIRE			
Galashiels (part of)	240	(c. 2)	(c.1,000)
TOTAL	131,332	c.553	c.16,341

[1] source: D.A.F.S., Agricultural Returns (parish summaries)

PHYSICAL CHARACTER

Structure and relief

The Lammermuir Hills comprise a plateau of tightly folded and steeply dipping Ordovician and Silurian grits and shales, fringed by hills of Old Red Sandstone. The whole is tilted to give, in the north-west, a steep scarp truncated by the Southern Upland fault and, in the south-east, a gentle fall toward the Berwickshire Merse (Fig. 2.2). Above the foothills that ascend from the Haddington plain the northern escarpment rises swiftly from about 245 m up to 300 m O.D. and levels out to form a plateau surface of 300-370 m O.D. Where the scarp is formed of sandstone it is deeply incised by streams into a series of spurs, but to the south the toughness and impermeability of the grits are reflected in an absence of entrenched streams. The general impression is one of an exceptionally smooth surface of gentle slopes covered mostly by heather or by Nardus-Molinia grassland.

Landform regions

The area may be divided into a number of regions in which contrasting physical character has induced a varied response from the limit of cultivation (Fig. 2.3). A brief description of these will enable reference to be made to them in the following chapters.

To the north of the Lammermuir scarp lies an area of level or undulating relief that may be termed the Lothian platform. Varying in height from 140 m to 245 m O.D., it forms part of a 'higher lowland peneplain' covered by a veneer of glacial drift (Ogilvie, 1928: 413). Over sections of the platform the combined effects of elevation, inadequate slope and intractable clay are critical for agriculture (Ogilvie, 1944).

South of the scarp the smooth ridges which form the remnants of the Lammermuir plateau provide a generally featureless skyline. Their southern extension, the Stow Uplands, is a monotonous rolling upland of flattish or gently curved hill-tops at elevations of 245-365 m O.D. In the extreme south of these uplands are outliers of the Corrugated Hills near Selkirk. Like the rest of the Southern Uplands they consist of tightly folded, almost vertically disposed Lower Palaeozoic greywackes and shales, but here the differential erosion of alternating hard greywacke and banks of softer rock has produced a micro-relief of closely spaced ridges and hollows that does not readily lend itself to improvement for cultivation (Ragg, 1960: 15).

At the opposite end of the study area the eastern Lammermuirs comprise a semi-circular belt of low relief. In the north-east the eastern hills consist of steep-sided residuals of Old Red Sandstone conglomerate, with overlying and imperfectly drained tills which have discouraged reclamation. To the south, however, Quixwood Moor and Coldingham Moor lie on tough greywackes that have contributed to a plateau-like surface. Lack of shelter from on-shore winds brings severe exposure that is a major restraint to cereal cultivation in the area.

In the south-east the Lammermuir plateau is breached by the deep valleys of the Whiteadder Water and its tributaries, leaving an outlier that may be termed the Duns Uplands, flat-topped hills of heather and Nardus that rise steeply from the valley floors.

Between this outlier and the Leader valley, at an elevation of 185-245 m, lies the Upper Merse, very gently inclined to the south-east and with a thick veneer of glacial till. Within this area two regions of raised but comparatively flat countryside, the Westruther and Gordon platforms, comprise the southern section of the peneplain which Ogilvie noted as being marginal to agriculture.

In the extreme south of the study area the Lower Merse is characterised by undulating, drumlinoid topography below 120 m O.D. The drumlins, together with the less regular ridges and mounds of re-worked till and fluvio-glacial sands and gravels, add variety to a landscape that would otherwise be monotonously regular.

Parent materials and soils

There are edaphic constraints on upland agriculture in the study area which have tended to determine not only the local pattern but also the elevation of former limits of cultivation. For this reason an introduction to the distribution of soil types is presented below, summarised from the memoirs of the Soil Survey (Ragg, 1960; Ragg and Futty, 1967).

A central factor in the varying fertility of soils in the region is the contrast between the tills that cover the area below the 245 m contour and the stony drift that is characteristic of the Lammermuir Hills and northern Stow Uplands. This is mirrored in a division between brown forest soils on the foothills and lowlands, and podzols and gleys in the uplands (Fig. 2.4).

The difference in fertility of these groups arises largely from varying drainage properties which have produced contrasts in status of lime (pH), phosphorus and potassium. The podzols are characterised by strongly bleached upper horizons and are extremely acid (pH 4.5 or less) (Ragg and Futty, 1967: 180). For successful cropping they require heavy liming, but even areas that have been under cultivation for long periods have soils of pH less than 5.7. The restraint on cropping is thus considerable.

Gleyed soils that are the product of waterlogging in areas of inadequate slope occur on level areas on Coldingham Moor, the Gordon platform and on the Upper Merse (Fig. 2.4). While requiring heavy liming to reduce acidity, their main disadvantage is an acute deficiency in potassium and a poor response by cereals to dressings of potassium concentrate.

By contrast the brown forest soils, including those with gleyed B and C horizons that occur at elevation on Quixwood Moor and the Stow Uplands, have a moderate lime status and are freely drained. Small deficiencies in potassium are readily made up and the soils have attracted cultivation from an early date up to about 305 m O.D.

Under regular grazing the podzols carry heather (Calluna vulgaris) and Molinia grassland. The gleys are characterised by rushes and sedges (spp. Cyperacae and Juncacae) and the brown forest soils by bracken-infested Agrostis grassland (Harper, 1962). The plateau above 425 m O.D. is generally covered by blanket peat (Fig. 2.4).

Climate

Edaphic restraints on upland cultivation are to a large extent the product of altitudinal increases in cold and wetness, but these factors themselves impose the most severe restrictions on cropping at high level.

The climatic restraints to an upward extension of cropping and their consequent influence on the spatial pattern of the limit of cultivation are considered in detail in Chapter 9 and do not require discussion at this stage, though it should be noted that, owing to shelter from the prevailing westerlies, the region is characterised by a low mean annual rainfall. Isohyets constructed from data for sixteen stations in the area exhibit an average of about 86-89 cm (34-35 inches) over the breadth of the Lammermuir Hills and a total of only 126.5 cm on the highest peaks (527 m O.D.) (Meteorological Office, 1964). Receipts of rainfall decrease markedly toward the east.

Above-average levels of exposure are evident, first, on the northern scarp which is open to westerlies spreading out across the Haddington plain and, secondly, on the moors of Coldingham and Quixwood which suffer from a high frequency of south-easterly gales. The alignment of shelter belts in both areas reflect these conditions (Fig. 2.5).

THE PRESENT AGRICULTURAL LANDSCAPE

Patterns of land use

The agricultural use of land in south-east Scotland is illustrated in Figure 2.5, constructed from observation in the field and from manuscript maps of the Second Land Use Survey that have been completed for about one-third of the study area. The definition of land-use categories follows those adopted by the Survey (Coleman, 1965), but it should be emphasised that the distribution of grassland and arable has been generalised to accommodate reduction of the final map to a manageable scale.

It is evident that there are three quite distinct zones of land use arranged concentrically around the Lammermuir Hills, viz., zones of rough pasture, grassland and arable. Rough pasture extends over about 56,640 ha and comprises 43 per cent of the study area. It is distributed over the entire range of the Lammermuir Hills with the exception of small pockets of improved land on the upper slopes of the south-eastern valleys. Of particular interest is its extension at a low level onto the Upper Merse, especially in the region of Greenlaw, and onto Coldingham Moor. Indeed, the elevation of the moorland edge exhibits a wide variation across the study area. On the northern scarp it averages 260-290 m O.D. and extends above 335 m at a number of locations. On the Stow Uplands it frequently exceeds 300 m, reaching its maximum elevation, 425 m, at Sell Moor (GR 480445). In contrast, average elevations are 230 m on the Upper Merse, 245 m on Quixwood Moor, and 215 m O.D. around a substantial outlier of moorland at Coldingham (Fig. 2.5). The regional pattern of the moorland edge, illustrated in Figure 2.6, thus exhibits a marked downward tilt to the south-east. An explanation for this may be higher levels of exposure in coastal areas compounded by higher mean temperatures in the north due to the moderating influence of the Firth of Forth. These factors are examined at length in Chapter 9.

The occurrence of local extremes in the elevation of moorland may, however, be explained in terms of soil and slope. High levels of improved land in the Stow Uplands may be partly due to, first, free drainage on the rounded summits and convex slopes and, secondly, soils of high base status developed from Upper Old Red Sandstone. On the platforms of the Upper Merse, however, inadequate slope has led to severe leaching and high acidity. In addition, the distance from sources of lime may be an historical factor that discouraged reclamation before the improvement of transport. Further discussion of these and associated factors is presented in Chapter 11.

The upper limit of a predominantly arable use of land follows the 185-200 m contours in the north-west, in Lauderdale and on the Merse. Along the coast and on the southern platforms, however, exposure or inadequate drainage seem to encourage a tendency to increased grassland (Fig. 2.5). The highest areas of arable, particularly those inliers in the grassland zone, are predominantly under turnips, oats and rape. Neither barley nor wheat are extensively grown above 185 m O.D.

Types of farming

This zonation of land use is broadly indicative of the distribution of three types of farming in the region: hill sheep farming on the moorland, livestock rearing with arable on the grassland zone, and arable with livestock feeding at the margins of the study area (D.A.F.S., 1941; Ray 1971a).

The hill sheep farms generally include a few enclosed in-by fields which are cropped with oats, turnips, rape or hay entirely as fodder for sheep and cattle. The main sources of income are lambs, wool, store cattle and draft ewes. The rough grazing is not enclosed, but the ewes are contained naturally by physical features into hirsels of up to 500, the allocation for one shepherd. The farms generally carry two to four hirsels at a stocking rate of one ewe to $1\frac{1}{2}$-$2\frac{1}{2}$ acres (0.6-1.0 ha) of hill, and vary in size from 1,000-5,000 acres (405-2025 ha). Most carry a few cattle, the balance between sheep and cattle depending on the quality of rough grazing and the availability of winter keep.

Livestock rearing and arable farms occupy most of the foothills of the Lammermuirs and much of the Stow Uplands and Upper Merse. Their main income is from the rearing of Cheviot or Half-bred lambs, but a characteristic policy is the breeding of beef calves for sale at six months or as stronger stores if adequate winter food is available. A typical rotation is grass ley for 4 to 7 years, grain, turnips or rape, grain; the ewes being folded on the turnips for a few hours daily through the winter. Farms average 800-900 acres (325-365 ha) and are tending to increase in size by amalgamation. Sales of barley have recently increased at the expense of oats, which are being replaced by bought-in feedstuffs (Ray, 1971a: 18, 25).

On low ground the system of farming is characterised by more intensive cropping and livestock feeding. Rotations on the Haddington plain consist typically of 2 or 3 years ley, grain, roots, grain, grain, but leys are reduced to a single year below the 90 m contour. Barley and wheat are the most important sources of income but, particularly on the higher farms, sheep and cattle are integral parts of the system.

In Berwickshire lambs are purchased from hill farms at the August store sales and fattened over the winter, but in East Lothian the emphasis is more on the stall-feeding of cattle brought in from Northern Ireland or other parts of Scotland.

EARLY SYSTEMS OF FARMING

It is convenient to consider at this point the ways in which early systems of agriculture differed from those presently adopted in the study area. The details of these systems will emerge from later discussion but an elementary understanding of them is a prerequisite of the accurate mapping of former limits of cultivation.

Medieval agriculture

In the first half of the twelfth century, settlement and reclamation of farmland moved onto the Haddington plain and the Upper Merse. The foundation of abbeys at Kelso, Melrose, Coldingham and Dryburgh between A.D. 1128 and 1153 played a major role in this advance through the erection of grange farms on land won from the woods and moors. Towards the end of the century granges were established in the Lammermuir Hills on sites high above the south-eastern valleys. They carried large flocks of sheep that were herded over extensive common grazings, but were also engaged in limited cultivation. The lower granges were oriented more toward cropping, and it seems that there existed a high degree of integration between upland and lowland, the hill granges providing young sheep and cattle in exchange for grain (Liber de Calchou, 1846, I: xxxii-xxxix). The success of upland agriculture practised by the abbeys has been attributed to this integration of stock and grain, both between granges and within the single farm (Waites, 1967: 26).

Evidence for methods of husbandry is scant. The main crops of upland farms were oats, bere (a four-row barley), peas and beans; except in the lowlands, wheat may have been grown only for payment of rent. The land was tilled into high ridges with heavy wooden ploughs drawn by eight to twelve oxen (Franklin, 1952: 6-8), the intermediate furrows which comprised up to one-third of the ploughed area being unproductive except in the driest summers. Thus, whatever the return to seed, output per hectare of tillage was inevitably small.

Pre-improvement agriculture

It seems likely that the rotations adopted by both monastic and lay farmers in the medieval period were similar to those incorporated in an infield-outfield system that was characteristic of Scottish agriculture before 1750. The system has been described in detail by Handley (1953: 38-45) and Dodgshon (1969: Ch. 5) and requires but brief summary here.

About one-third of the farmed area, generally that which surrounded the farm steadings, was cultivated as infield, on a rotation of bere, oats, oats. All available manure was applied to the crop of bere only. Sections of the outfield were folded with cattle before the first crop of oats, which was followed by as many as would continue to provide an adequate return. The land was then allowed to revert to natural grass and sedge to recover its fertility over four or five years. The entire arable area was often divided from the upland moors by a turf and stone head-dyke which prevented untended cattle from grazing on cropland (Robertson, 1949). In south-east Scotland, however, the emphasis on hill sheep rather than on agistment of cattle reduced the need for division between arable and moor. In the study area, unlike most of the Scottish Highlands, the head-dyke is not a characteristic feature of the relict upland landscape.

In the eighteenth century some adjustments were made to this traditional system. On the Haddington plain the infield was divided into four brakes of peas, wheat, bere and oats (Hepburn, 1794: 49), while in Coldingham the outfield, which comprised three-quarters of the farmed area, was cropped for three years and then fallowed for six (OSA, XII: 50). It was still true, however, that only about one-quarter or one-third of the land was cropped perennially and that the remainder was cultivated on average only one year in two or three. Little more than a third of the arable area was thus productive at any one time.

Since it is generally true that the outfield was located on land most remote from the farm steading, the upper limit of cultivation was almost always the edge of the outfield and thus land at the limit was cropped only with oats. In the medieval period this was probably the 'grey' or 'small' oat which was replaced in southern Scotland by the 'common Scotch' oat (Avena strigosa) (Hunter, 1924: 13).

Improvement in agriculture

The first significant alteration of production by this system was due to the liming of both infield and outfield in the early seventeenth century, the evidence for which is presented in Chapter 8. Indeed, the origins of the widespread improvement in agriculture are likely to lie in this period. Yet the bulk of the 'agricultural improvement', as the revolutionary change in Scottish farming is generally termed, occurred between 1770 and 1815 (Handley, 1963). It included the rapid enclosing of arable, the adoption of new crops, particularly turnips, clover and sown grasses, the planting of shelter-belts and the improvement of drainage. The synthesis of such innovation was the replacement of the infield-outfield system by regional modifications of Norfolk husbandry. The rapidity and extent of change in both farming practice and in the rural landscape make these developments far more worthy of the term 'revolution' than concurrent trends in England. This improvement of Scottish agriculture lies behind many of the changes in the limit of cultivation over the period A.D. 1600-1900 and is discussed at length in later chapters.

CHAPTER 3

CHANGES IN THE LIMIT OF CULTIVATION, 1860-1970

In this chapter it is demonstrated that changes in the upper limit of cultivation after 1860 may be interpreted with relative accuracy from published records. These fail to account, however, for the quantity of abandoned land that is evident in the study area. The problem is thus isolated as one of mapping, dating and explaining changes which occurred before 1860.

Some idea of movement by the limit of cultivation over the last century may be gained from a study of successive editions of Ordnance Survey maps. The handbooks of instruction for surveyors indicates that the moorland edge on these maps is defined as the division between land under cultivation (including developed pasture) and areas of natural or semi-natural vegetation (H.M.S.O., 1952, B, V: 79a). Comparison between Ordnance Survey maps and tithe apportionments of similar date reveals close measure of agreement on the distribution of moorland (Chapman, 1961: 208; Coppock, 1969); and in the study area this has been confirmed by comparing the moorland edge of the sixth series Ordnance Survey one-inch maps with the limit of cultivation on contemporary aerial photographs. There is consistent agreement between the two.

Yet the value of the maps to a study of moving limits of cultivation rests on their accuracy of survey and consistency of interpretation. Surveyors were instructed to note areas of moorland exceeding 0.25 ha and it is reasonable to suppose that these were meticulously recorded (H.M.S.O., 1952, B, V: 79b). Changes in interpretation of moorland between revisions of the maps are, however, less readily assessed. The duties of field revisers included the survey of changes in extent of rough pasture (H.M.S.O., 1952, J, 2), but it is possible that minor differences in definition of rough pasture by individual surveyors are incorporated as adjustments of the moorland edge on successive editions of the published maps. Synoptic changes in the maps, however, are likely to reflect real adjustment of moorland.

With these reservations in mind, it is possible to assess recent changes in the moorland edge from a study of successive Ordnance Survey maps. Maps of six-inch scale (1:10,560) were found to be most suitable since they exhibit all relevant detail incorporated in 25-inch (1:2500) plans and Area Books. The history of revision for the study area is presented in Table 3.1.

The location of the moorland edge is thus known for the following periods: 1853-60, 1892-8, 1905-6, 1916-23, 1952-4, 1961-4. Information is also available for 1932-6 from the Land Utilization Survey, but its comparability with Ordnance Survey maps is questionable since it is likely that different criteria were used in the mapping of rough pasture. Yet the Survey was carried out at the nadir of the depression and is therefore a particularly valuable link in the chronology of change at the moorland edge.

Trends of reclamation and reversion throughout this chronology are illustrated in Figures 3.1-3.7 and are summarised in Table 3.2.

Table 3.1

History of Ordnance Survey revision in south-east Scotland

	East Lothian	Berwick-shire	Mid-lothian	Roxburgh-shire	Scale
survey	1853	1855-7	1852-4	1857-60	1:10,560
re-survey	1892-3	1896-8	1892-4	1895-8	1:10,560
full revision	1906	1905-6	1905-6	-	1:10,560
full revision	1922-3	1922-3	1922-3	1916-19	1:63,360
partial revision	1938*	1938*	-	1938*	1:10,560
partial revision	1952-3	1952-3	1953-4	1953	1:10,560
full revision	1963	1963-4	1963	1961-2	1:63,360

* part of county only

Table 3.2

Changes in extent of moorland, 1860-1970

	Area reclaimed (ha)	Area reverted (ha)	Total moorland	% Change
		(1853-60 = 57,980)		
1853-60 to 1892-98	5,760	785	53,005	-8.6
1892-98 to 1905-06	2,680	560	50,885	-4.0
1905-06 to 1916-23	1,640	1,700	50,945	+0.12
1916-23 to 1932-36	20	3,940	54,865	+7.7
1932-36 to 1952-54	2,380	1,440	53,925	-1.7
1952-24 to 1970	2,160	860	52,625	-2.4

Sources: Ordnance Survey, Land Utilization Survey, field work.

The extent and direction of change

A comparison of Figures 2.6 and 3.1 illustrates the contrasting location of the moorland edge in 1860 and in 1970. Over this period it is evident that the area of moorland was reduced by over 5,355 ha or 9.2 per cent (Table 3.2). The centres of marked reclamation appear to have been the Stow Uplands, the Upper Merse and the Coldingham outlier, where rough pasture was more extensive in the last century. But there is also evidence of a retreat of improved land from the highest parts of the south-eastern valleys. These trends of advance and retreat may be studied in six consecutive phases.

1. 1860-96 (Fig. 3.2)

Over the second half of the nineteenth century reclamation was widespread over most of the study area. It seems, however, to have been particularly extensive in the Stow Uplands at elevations above 300 m O.D. and along a belt of land to the south and east of the Lammermuir Hills which correlates broadly with the platforms of moderate elevation and inadequate slope. Attention will be directed later to the question of whether this advance represents the initial reclamation of virgin moorland or the secondary intake of earlier abandonment (infra p.192). It is possible, however, that it was a response to the introduction of tile drainage during the period of prosperity in agriculture, 1860-1880.

Of equal interest is the abandonment of farmland, mostly at remote and elevated sites on the fringes of the Lammermuir Hills, which may have occurred after the collapse of cereal and stock prices in the 1880s.

The balance of change is, however, very much an advance of improved land, resulting in a decrease of 8 per cent in the area of rough pasture.

2. 1896-1905 (Fig. 3.3)

Continued reclamation at the turn of the century when the national outlook of agriculture was bleak and when contradictory trends are evident elsewhere (Chapman, 1961: 226-30), throws suspicion on the consistency of revision by the Ordnance Survey. Yet the distribution of intake and reversion in the study area suggests that the pattern illustrated in Figure 3.3 reflects real change, for the advance of improvement on the Upper Merse and the scatter of abandonment on the highest farms was a trend established in the period of high farming.

3. 1905-23 (Fig. 3.4)

In the following decade the pace of advance appears to have slackened, though it continued to be directed toward the Westruther and Gordon platforms and to the Stow Uplands. Conversely, there is evidence of an acceleration of the rate of reversion, some of it on land that had been taken in not long before. It is possible that wartime reclamation and subsequent abandonment caused an upward climb of the moorland edge in the intervening period, but the timing of the surveys provides for assessment only of the balance of change over the entire period. It points to an overall expansion of moorland for the first time since the mid-nineteenth century.

4. 1923-32 (Fig. 3.5)

The extensive reversion of farmland suggested by the Land Utilization Survey accords with contemporary comments on the increase of rough pasture during the inter-war depression (Waite, 1941: 29). But both the quantity and distribution of reversion is the product of a variety of interpretations that may have been placed on the definition of moorland by the large number of individuals employed in the survey.

With these reservations, two distinct patterns may be outlined. First, a high proportion of the reversion in the Stow Uplands, the Upper Merse and on Coldingham Moor occurred on land that had recently been reclaimed. Secondly, the remaining abandonment was concentrated once more at high level in the south-east valleys and also in Lauderdale, at Fala Moor and along the northern escarpment.

5. 1932-53 (Fig. 3.6)

Less than one-third of the inter-war reversion had been brought back into cultivation by 1950, and there was a further retreat of farmland in the uplands in the intervening period. Indeed, the Ordnance Survey maps suggest that the area of rough pasture had expanded by almost 3,000 ha (5.8 per cent) over the second quarter of the century.

6. 1953-70 (Fig. 3.7)

Some of this was reclaimed in the post-war period, but recent advance has been concentrated more on the foothills of the Lammermuirs than on traditional areas of intake. Many of the nineteenth century intakes which were abandoned between the wars therefore remain rough pasture. About 6,550 ha or 11.4 per cent of moorland at present in the study area has been cultivated at one time in the previous century but now lies under rough vegetation.

Disappearance of farm steadings

The trend toward retreat of the limit of improved land from the highest parts of the study area is reflected in the disappearance of farm steadings from successive editions of Ordnance Survey maps. At least 104 steadings were abandoned between 1860 and 1970, 64 of these over the period 1860-96. Their distribution, which is illustrated in Figure 3.8, exhibits a close affinity to the patterns of contemporary land reversion, the implication being that a causal relationship exists between the abandonment of farmland and the abandonment of steadings, probably due, in turn, to a process of farm amalgamation. The suggestion is that, where reversion of land is accompanied by disappearance of farm steadings, it is less likely to be reclaimed than is land for which the farm unit remains intact. A distinction may thus be made between, first, land that tends to fluctuate between conditions of improvement and waste and, secondly, land with a tendency to more permanent abandonment.

Conclusion

Types of land-use change at the moorland edge may be more clearly distinguished by examination of total changes that have occurred over 1860-1970. Two trends have been evident throughout this period: the reversion of the highest and most remote land, and the fluctuation of intake and reversion in the Stow Uplands, Upper Merse and eastern Lammermuirs. Within the second zone, however, it is possible to isolate three distinct changes in land use: first, land that has reverted and not since been reclaimed, secondly, land that has been reclaimed and not since abandoned and, finally, land that has been both reclaimed and abandoned - perhaps more than once - over the last century.

The distribution of these changes is illustrated in Figure 3.9. It defines an area that, by reason of its location, soils, physiography or even history, has been marginal to cultivation at one time over the period 1860-1970. The land which is characterised by either reclamation or abandonment may be the product of single, perhaps major, changes in the profitability or technology of cultivation, for example by the introduction of tile drainage in the mid-nineteenth century. It is clear that this area may no longer be marginal to cultivation. But land which has often fluctuated between cultivation and rough pasture is an indicator of areas that have consistently lain at the margin of profitable cultivation. It is centred on the Stow Uplands, the Westruther platform and the lower south-eastern valleys, but is also scattered thinly around the fringe of the entire upland area (Fig. 3.9). The scarcity of this land along the northern scarp is evidently a reflection on the lack of alternatives imposed on cultivation by abrupt relief.

In addition, it is possible to outline a lowland area that has remained improved throughout the last century. Its upper limit is defined by the greatest advance of moorland during the period and may be termed the 'maximum moorland edge' (Fig. 3.9). Above the zone of marginal land lies a 'moorland core' that has been consistently classified by the Ordnance Survey as rough pasture since 1860. It is circumscribed by the greatest extension of cultivation during the period which may be termed the 'minimum moorland edge'.

CHANGES IN THE LIMIT OF CULTIVATION BEFORE 1860

There is a strong suggestion, however, that cultivation was widespread in the moorland core at some period prior to 1860. First, a reconnaissance survey of the study area has revealed extensive plots of relict cultivation ridges lying under heather at sites well above the minimum moorland edge. The rounded summits of the ridges and their sinuous form point, prima facie, to an early origin (Bowen, 1961: 47). The survey also indicated the existence of numerous sites of deserted farmsteads which are not recorded on any Ordnance Survey map. They are frequently associated with vestigial dykes and tracks and their proximity to the abandoned cultivation suggests a functional relationship. The implication is that not only was cultivation at one time extensive in the hills but that it was conducted over a sufficient length of time to attract permanent settlement.

Secondly, there is evidence for more extensive upland cultivation in a number of early manuscripts and publications. Dodgshon (1969: 275) has recorded reports of farms on the northern foothills of the Cheviots on which cultivation was substantially greater in the mid-eighteenth century than at the height of temporary expansion during the Napoleonic Wars. Moreover, in the south part of the Ettrick Forest, in Selkirkshire, Robson (personal communication, 1971) has noted the abandonment of several upland farmsteads in the periods 1675-1700 and 1750-1770.

In the Lammermuir Hills there are numerous reports in the Statistical

Account of Scotland (1791-99) of the disappearance of farms toward the end of the eighteenth century, including some specific accounts of formerly extensive tillage on high land. In the Upper Merse, north of Greenlaw, it was noted in 1795 that some land had once been reclaimed but had not been in tillage for more than a century (OSA, XIV: 513). Indeed, even at the peak of high prices and the move to extend cultivation, contemporary writers were awed by the quantity of former cultivation

> The quantity of ground [in the Lammermuir Hills] that has at different times been under the plough is so great, that it is hard to say, unless it was to extirpate the heath what could be the inducement.
>
> (Farmer's Magazine, 1803: 508)

The suggestion is, then, that a large proportion of the uplands in the study area was once cultivated, that this land fell back to moor before 1860 and has not since been brought under the plough.

The problem isolated

Since changes in the limit of cultivation after 1860 may be traced relatively simply from Ordnance Survey maps, and since there exists *prima facie* evidence of abandonment before 1860, the problem may be resolved into three questions:

1. Which land was formerly cultivated but was abandoned some time before 1860? What was its extent?

2. When was it reclaimed and when abandoned?

3. What were the reasons for its reclamation and abandonment?

The approach

The answer to the first question clearly lies in the mapping of former limits of cultivation in the study area; that to the second will be provided by a chronology of an advance toward the maximum limit of cultivation and a subsequent retreat; the date of advance and retreat may point to their explanation.

In the following parts of this study, therefore, consideration is given first to the mapping of abandoned land and of deserted settlements. In Part III the dates of reclamation and abandonment of the mapped areas are examined. It includes an assessment of changes which occurred over the years 1860-1900 since this period was characterised in south-east Scotland by extensive intake and reversion of land that may reflect profound changes in agricultural prosperity. In Part IV an explanation is sought for the elevation to which early cultivation extended and for subsequent abandonment.

PART II

THE MAPPING

CHAPTER 4

MAPPING THE RELICT LANDSCAPE

In the preceding chapter the maximum upland extension of the limit of cultivation was established for the period 1860-1970. A 'moorland core' of 44,080 ha, none of which has been cultivated in the last century, lies above this limit. Yet there is a body of prima facie evidence which suggests that cultivation at one time extended far into the moorland core, pointing to tillage of a substantially earlier date, abandoned before the mid-nineteenth century.

In this chapter an attempt is made to map, as accurately and comprehensively as is permitted by the available evidence:

1. the location and quantity of land within the moorland core that has in the past been cultivated, but which was abandoned before 1860.

2. the upper limit of cultivation existing before 1860 which may in some areas have lain outwith the moorland core and below the limits of cultivation of the last century.

Emphasis is placed on the need for an accurate assessment of the extent of locational change of the cultivation limit. The early documentary material which may account for past fluctuations of marginal agriculture is scarce; thus part of the explanation for change must be sought in the pattern and location of the abandoned land itself. In a small study area minor omissions of evidence or errors in its interpretation may bias the pattern and invalidate the procedure.

The development of a sensitive mapping technique is therefore of particular importance. It is outlined in detail since the methodology to be used in south-east Scotland may be applied in similar studies in the Scottish Highlands. Consideration is given below to:

1. the selection of sources of evidence for the mapping of past cultivation.

2. the development of techniques in the interpretation from aerial photographs of relict features of the upland landscape.

3. the mapping procedure and the evaluation of its accuracy.

4. the results.

SELECTION OF THE EVIDENCE

Sources for the mapping of early cultivation are extremely variable. Some provide an accurate record for a very limited area at a specific date while others depict broad patterns over uncertain periods. Consideration is given to each major source to establish which is the most comprehensive in area and in time, and which offers the most advantages to swift and inexpensive mapping. Attention is directed first to the field evidence and, secondly, to evidence in manuscript and published records.

The field evidence for early cultivation

Field indicators of the pre-Ordnance Survey limits of cultivation are available either as landscape features which are relics of the early methods of cereal production or as indirect effects on present patterns of vegetation and soils.

1. Evidence from the relict landscape: cultivation ridges

A number of relict features are apparent on the modern landscape, both upland and lowland, which are the legacy of past agricultural activity. Their appearance depends much on the treatment to which they have been subjected since their abandonment and on the type of vegetation cover under which they now lie. If they can be identified and mapped they may provide a detailed picture of early agricultural activity. It is important to establish, however, their comprehensiveness as indicators of past cultivation.

The most widespread feature of the relict agricultural landscape is the cultivation ridge, or ridge and furrow. Its general form has been described by Bowen (1961: 46-50) and local variants in south-east Scotland are explained in detail by the Board of Agriculture reporters (Hepburn, 1794: 51; Kerr, 1809: 192-5; Somerville, 1805: 88-91). These descriptions need not be reiterated here. But while the characteristic shapes of the ridges are well known, their function is not. There has been a long, sometimes pedantic, argument among English economic historians as to the purpose and significance of ridge and furrow (Jackson, 1961). Yet the only indisputable facts that have emerged from the discussion are, first, that all ridge and furrow land has at some time been under the plough and, secondly, that it was constructed by the mould-board plough (Kerridge, 1951; Bowen, 1961).

A map of abandoned cultivation ridges in the moorland core of the Lammermuirs would thus certainly represent areas of former cultivation. The difficulties of identifying the ridges among moorland vegetation, more especially of distinguishing them from other similar linear features such as choked sheep drains and erosion rills, are discussed later (infra p.69). There is no doubt, however, that if sufficient accuracy were achieved in the recognition and mapping of the ridges the final map would illustrate the location of abandoned cultivation.

The landscape record may not be comprehensive, however, for not all pre-improvement cultivation may have included the construction of plough ridges. Thus, if the location of past limits of cultivation are to be mapped from relict landscape evidence, it is important to establish the role of the plough ridge in early upland agriculture and the degree to which it comprehends all early tillage. This can be done by giving initial consideration to its raison d'etre.

Function of the cultivation ridge It has been suggested that cultivation ridges are the product of ploughing with a fixed mould-board, one which casts the furrow slice to one side of the plough only (Bowen, 1961: 10-11). Such a plough cannot work simply back and forth over the ground without turning the furrow slice onto unploughed land. It is necessary therefore for the plough-team to travel in a concentric pattern around a central starting line, and to avoid excessive waste of time by the plough moving 'free' along an ever-widening headland, the field is divided into a number of parallel lands around which the concentric pattern is worked. The result is a series of low ridges. One hypothesis thus holds that ridge and furrow is consequent on use of the fixed mould-board plough; that, before the advent of the reversible plough, it was the only technique which ensured full tillage of the ground (Nightingale, 1953; Ransome, 1867: 93). The implications of this argument to the comprehensiveness of ridge and furrow as an indicator of abandoned cultivation will become apparent in the following section.

A second hypothesis (Beresford, 1948, 1950) proposed that ridge and furrow represented strip holdings on medieval openfields, the inference being that the ridges were constructed for the specific purpose of identifying the strips (Beresford, 1948, 1950). This is given some support by the lack of correlation in parts of lowland England between slope and ridge alignment, and between ridge width and soil drainage properties (Clark, 1960).

The balance of more recent work, however, suggests that ridge and furrow fulfilled an essential drainage function. The great body of evidence for this argument rests with contemporary published works on agriculture which include frequent advice to farmers on the optimum relation of the heights and widths of ridges to soil wetness. Early mention of this is made in an English work of 1616 (Miles, 1903: 101), and in Scotland similar specific recommendations are made by Adam Dickson (1762: 253, 278-281), Lord Kames (1776: 62), George Robertson (1829: 210-215) and by many of the Board of Agriculture reporters, two of whom were writing of the Lammermuir area (Kerr, 1809: 192, 223; Somerville, 1805: 91). Indeed the conclusion that may be drawn from most early agricultural literature is that, in Scotland at least, the cultivation ridge was essential for adequate drainage.

Furthermore, the fact that ridging of the land continued to be a common practice well after the introduction of the swing-plough (which incorporated a smaller mould-board less suited to the construction of ridges than the 'old Scotch' plough) suggests that the mould-board was secondary to the demands of drainage. It is clear that by 1795 the swing-plough had replaced the 'old Scotch' plough in south-east Scotland in all but the most remote parishes (infra 151). Yet ridge cultivation remained the universal means of tillage in Scotland until the late nineteenth century on cereal land that was not underdrained (Morton, 1855, II: 808).

The hypothesis of a drainage function for cultivation ridges is also strongly supported by evidence from the modern landscape. Ridges and furrows on moorland in the study area exhibit marked differences in their plant communities, the most common being a heather-dominated community on the ridge crests alternating with Nardus stricta and Juncus spp. in the furrows. In moister areas a ridge community of Nardus-Molinia contrasts with Juncus spp. and sphagnum. These vegetation patterns are a valuable means of identifying abandoned cultivation ridges in moorland and will be considered in greater detail later (infra p.83). It is significant that they are indicative of contrasting soil wetness from ridge to furrow even where the amplitude of ridge and furrow has been greatly reduced by erosion, silting and trampling by livestock. Similar patterns have been noted in eastern Niedersachsen by Meibeyer (1969), and in the Vale of York by Booth (1967).

Universality of the cultivation ridge It has been important to establish the critical role of the cultivation ridge in soil drainage in upland agriculture, because most English historical geographers have been content to assume only a partial drainage function (Mead, 1954; Harrison, Mead and Pannet, 1965; Harris, 1966). This hypothesis is fundamental to an evaluation of the universality of the cultivation ridge, particularly in the moister areas of upland, northern and western Britain.

It is evident that in southern Scotland successful cereal cultivation without artificial drainage is probably impracticable in areas characterised by a potential water deficit of less than 50 mm (above 75-125 m O.D. in the study area) and certainly impossible in regions with less than 20 mm (above 125-150 m O.D.) (infra 283). With the exception of free-draining soils on south-facing slopes, moisture levels would normally far exceed the minimum requirements for crop ripening. Critical levels of soil moisture are discussed in Chapter 10; but in the present context it is sufficient to note that adequate artificial drainage would have been required, particularly in the moorland core of the study area where potential water surplus exceeds 20 mm, to ensure a sufficient probability of an adequate return to seed.

Until the widespread acceptance of underdrainage in the mid-nineteenth century, cultivation ridging remained the only method of plough husbandry which offered improved drainage (infra pp.133-4). Thus the acceptance of a drainage function for ridge and furrow would imply that all early cereal husbandry by the plough, at least in those parts of the study area above 150 m O.D., was performed on cultivation ridges.

Under the first hypothesis for the raison d'etre of ridge and furrow, that of a technological necessity produced by the fixed mould-board plough, the universality of the cultivation ridge to cereal husbandry is more certain. It will be demonstrated later that the heavy mould-board plough was introduced to south-east Scotland in post-Roman times and was in widespread use in the early medieval period. From this time until its replacement by the swing-plough in the late eighteenth century it was probably the only type in use (Jirlow and Whitaker, 1957). If Nightingale's argument (1953) that ridge ploughing was always the product of the fixed mould-board is accepted there is, therefore, a strong case for assuming that all early cultivation by the plough in south-east Scotland was in ridge form. It is, in fact, clear that a modified form of ridge and furrow, levelled and straight, remained in almost universal use in the marginal areas of cereal cultivation either until the period 1850-70 when much of the Lammermuir foothills were tile drained or until the move from tillage to grass on marginal land in the 1880s (infra p.286).

If it is likely, then, that all cultivation by the plough was in ridges, the question remains as to the quantity of cultivation performed by the spade. The application of paring and burning to reclamation had been introduced to south-east Scotland by the early eighteenth century, but is not mentioned after 1809 (Fenton, 1970a). It may have been used for catch crops of cereals on dry moorland areas in times of high prices and may not have included the ridging of land. In most recorded cases, however, it is associated with cultivation ridges, normally gathered by the plough. Narrower and lower spaded ridges have been noted in the western Highlands but were employed in eastern Scotland only for the cultivation of potatoes (Fenton, 1962-3). The suggestion is that all but a limited amount of ephemeral cereal cultivation in the study area was performed on ploughed ridge and furrow.

It may be concluded that almost all cereal husbandry practised between the early medieval period and the mid-nineteenth century in south-east Scotland was dependent upon the construction of cultivation ridges by the plough. Cultivation ridges are thus a comprehensive indicator of past tillage within the moorland core. If they are sufficiently well preserved and not masked by deep moorland vegetation, and if they can be identified with sufficient accuracy in the field, they may be used as evidence for the location and extent of post-Roman but pre-Ordnance Survey limits of cultivation.

Cultivation ridges on improved land In those parts of the study area in which there is no evidence of early cultivation within the moorland core, the suggestion is that cultivation has recently extended beyond the pre-Ordnance Survey limits. In these areas the traces of ridge and furrow beneath improved or recently reverted land can help to establish the earlier limit of cultivation.

Clearly the evidence is less comprehensive than that for the moorland core since many of the ridges have been levelled and some entirely removed by under-drainage and frequent cross-ploughing.

2. Evidence from the relict landscape: other features

A number of other relict landscape features may be used to map early limits of cultivation.

Clearance cairns Cairns consisting of stones and boulders collected from reclaimed land have been used to identify sites of past cultivation, but these generally antedate the present period of study (Graham, 1956-7; Scott-Elliot and Rae, 1967). In north-east England they have been found to date from the late Bronze Age, although in south-east Scotland it is probable that they continued to be constructed in the late Iron Age or Romano-British period (Fleming, 1971; Phillips, 1963: 141).

After the replacement of the ard by the mould-board plough, clearance cairns became redundant, the cleared stones sometimes being thrown into the cultivation furrows and later being used in the construction of dykes. Cairns reappeared, however, in the middle and late nineteenth century when ridge and furrow became obsolete, and may be used as an indicator of post-improvement reclamation. They are particularly valuable in the identification of areas reclaimed in the 1860s and 1870s which reverted to permanent moorland after the collapse of prices in the 1880s. These trends are not recorded by the Ordnance Survey since they occurred during the period between the surveys for the first and second editions for the study area.

Deserted settlements Sites of farm clusters (clachans) or single farmsteads in Scotland have been the subject both of detailed archaeological study (Fairhurst, 1960; Petrie and Fairhurst, 1964; Fairhurst, 1971; Dunbar, 1971) and of general reviews (Gailey, 1961; MacSween, 1959b). They have not, however, been used as indicators of the advance and retreat of the limits of settlement and cultivation as they have in Scandinavia and Iceland (Enequist and Norling, 1960; Stone, 1971), and in parts of tropical Africa (Gleave, 1965, 1966). This is surprising for they are a characteristic feature of the Scottish relict landscape and their relation to synoptic limits of cultivation is a close one. But as pointers to the distribution of abandoned land on the large scale they are generally less satisfactory, since the extensive nature of the infield-outfield system ensured that widespread areas of cultivation were located at considerable distances from the farm steading.

Enclosing dykes A more specific indicator of the detailed limits of past cultivation are the remains of enclosing dykes and shelter belts. They are almost always associated only with post-improvement cultivation, and their value is limited to the mapping of more recent trends.

The only early features of enclosure are head-dykes and small kail or stack yards associated with farmsteads. As neither is common in the study area, their use is restricted to the dating of areas in which they occur rather than to the mapping of abandoned farmland.

The remains of shieling bothies, access roads, drove routes and cut-over woodland comprise a body of indirect evidence for the overall location of early agricultural activity. In the study area, however, their distribution is generally limited.

It is clear, then, that landscape evidence for the mapping of abandoned land is restricted to the cultivation ridge and the settlement site. Other features tend to lack the comprehensiveness required for a complete survey. However, they are valuable pointers to the dating of those sites with which they may be associated.

3. Evidence from vegetation patterns

In certain areas it is possible to identify abandoned cultivation from the pattern of upland vegetation (Fenton, 1952: 61-64). The presence of grassland areas, especially those of Agrostis tenuis and Festuca ovina, may sometimes point to sites of low acidity and free drainage, perhaps promoted by early tillage and perpetuated by the selective grazing and dunging by sheep. Miller (1967) has suggested such a process in the preservation of grassy areas around abandoned shieling sites in the Scottish Highlands.

The pattern is complicated, however, by grazing densities, the frequency of burning and the distribution of woodland. Fenton has implied that vegetation patterns, particularly of bracken (1952: 67-68), blaeberry (1951b: 44) and of certain mosses (1937), are more accurate indicators of these than of cultivation. Moreover plant communities in woodland may be so sensitive to changes in soil drainage and acidity that past patterns are soon remoulded by more recent processes (Gimmingham, 1949).

The conclusion is that while vegetation types may support other evidence for abandoned farm land in specific areas, they are an unreliable indicator of synoptic patterns of the former limits of cultivation.

4. Evidence from soil profiles

Taylor (1965a) has shown that the presence of shallow mineral horizons below contemporary surface root mats may indicate early cultivation at high altitides. The digging of soil profiles is not a practicable method of mapping over large areas, but it may provide supporting evidence for sites for which the other indicators are in doubt. This may be particularly true for ephemeral late nineteenth century reclamation not indicated by cultivation ridges or by clearance cairns.

Evidence for early cultivation in manuscript and published sources

1. Evidence on large-scale county maps before 1860

Thirty-four printed and six manuscript maps at scales ranging from 1:30,000 to 1:300,000 are extant for the counties of Midlothian, East Lothian, Berwick and Roxburgh. Their content and accuracy vary greatly, generally increasing with more recent date of survey. An evaluation of the date, completeness and accuracy of the maps is presented in Chapter 5, where it is concluded that fourteen are worthy of detailed study.

There is thus extant for the study area a comprehensive coverage of maps for the periods 1610-54, 1682, 1745-56, 1771-73, 1797-1810, 1825-38. Problems of dating and plagiarism (Coppock, 1969) can be overcome through careful cross-checking and the use of supporting documentary material (infra p.108).

Only one map, the Military Survey of 1745-56, delimits the upper edge of cultivation, and although this has been used to outline the distribution of woodland in mid-eighteenth century Scotland (O'Dell, 1953), it will be shown later that serious doubt may be cast on its accuracy (infra pp.101-6).

Indirect evidence of land use is available on all the selected county maps from the distribution of estate policies, enclosed field patterns and shelter belts. The map sequence can thus be used to illustrate the uphill extension of the limits of improved agriculture. But no such information is available for the upper limit of open-field cultivation, which represented the maximum extent of tillage up to the time of complete enclosure in the late nineteenth century. The only indication on the maps of the location of upland tillage lies in the distribution of settlement; and it has been noted that the spatial association of steading and farmland was a loose one.

Moreover, the map sequence provides a record for only six dates prior to 1860. The reclamation and abandonment of land, or the establishment and desertion of associated settlement, that may have occurred between or before those dates are not recorded.

While large-scale county maps have sometimes been used to locate early agrarian change (Lebon, 1952), they are, therefore, unsatisfactory as a primary source for mapping past movements of the limit of cultivation. They are valuable, however, as indicators of the permanence and of the date of early upland cultivation, and later use is made of them for these purposes.

2. Evidence on estate plans

The value of estate plans to the study of agrarian change in Scotland has been increasingly recognised (Third, 1953, 1954, 1957; Adams, 1966, 1970, 1971). Their coverage, however, especially in upland regions, is restricted both in area and in time. There is extant for the Lammermuirs a coverage of estate plans for about one-third of the area, a high proportion in comparison with the remainder of Scotland and one which in part determined the choice of the region as a study area. But the distribution of the plans is uneven (Fig.11.3). Large parts of the Stow Uplands and western Lammermuirs are not represented and for those areas which are well covered the plans are clustered over the period 1815-1860. Almost two-thirds of the coverage was surveyed at this time.

Thus, while there is often detailed information available for land use at certain dates for specific areas, the plans fail to provide a comprehensive record which would be useful to the mapping of former limits of cultivation over broad areas. Their use is restricted to the dating and explanation of established patterns (Chapters 8 and 11).

3. Evidence from published sources and estate MSS

Published and manuscript texts There are a number of sources which record the existence of settlement or agriculture on specific properties at given dates. Many of the early charters of both monastic and lay lands note the extent of early cultivation in their descriptions of the properties to which they pertain. Similar information is available in later charters and in the Register of the Great Seal in which a brief valuation of property is made (Thomson, 1912). A more detailed valuation of inherited property was recorded in the Retours of Special Services which are extant from 1546 to 1700 (Thomson, 1811). This source enables an estimate to be made of the proportion of improved or cleared ground on estates for which the total acreage is known.

Less comprehensive valuations are available from 1617 in the Register of Sasines, but the most valuable record is contained in the parish teinds which from 1629 were fixed at one-fifth the annual rent, assuming the rent to be one-half the annual produce of the land. This proportion also governed the kind (stock, kain or grain) in which the teind was paid. It is thus possible to establish the pattern of production on a particular property.

None of these sources is, however, areally comprehensive. Scattered properties are represented at a variety of dates, and even the most thorough search would not provide a complete record of the location of upland cultivation over the whole period.

Estate manuscripts The use of estate documents has similar disadvantages. While estate rentals, factorial accounts and inventories often record the location and extent of cultivation, the information is restricted to certain areas and to specific periods. The coverage of such documents is limited to the late eighteenth and early nineteenth centuries and is concentrated on the four estates of Whittingehame, Dunglass, Innerwick and Marchmont. They are most valuable in the dating and explanation of changes in cultivation.

Temporal and spatial restrictions on recorded data thus limit their application for the mapping of abandoned land.

4. Evidence from place-names

Philological evidence for past cultivation may be widespread in upland regions since early place-names are less likely to be replaced or corrupted in remote than in accessible areas. A record of settlement which can represent a cross-section of the agricultural period may thus be preserved. This has advantages over written records which refer only to a limited selection of specific dates.

A search for place-names in the moorland core which indicate past settlement and agriculture by Gaelic- and Cumbric-speaking peoples, or by a later Norse population can point to locations of early cultivation. The philological record, however, is scant. The work by Milne (1912) in East Lothian and by Johnston (1940) in Berwickshire demonstrates the difficulties of interpreting anglicised gaelic place-names. More recent work has succeeded only in painting a broad picture of population movement in south-east Scotland (Dixon, 1947; Williamson, 1943; Nicolaisen, 1964). It is not possible to assess the number of clearance, field or tillage names that have been lost from the record or have been corrupted beyond recognition.

Conclusion

It may be concluded that there are available for the study area two means by which the location of past limits of cultivation may be comprehensively surveyed. These are by the mapping of selected features of the relict landscape and by the study of large-scale county maps. The most effective approach appears to comprise:

1. the mapping of abandoned cultivation ridges and of settlement sites in the field

2. the analysis of settlement distributions on county maps to confirm the fieldwork and to establish the degree of permanence of the early cultivation.

Other sources, particularly estate plans and manuscripts, will be used to date the surveyed areas (Chapter 8).

An analysis of settlement recorded on the county maps is made in Chapter 5. In the following section consideration is given to the most suitable method of mapping cultivation ridges and abandoned steadings.

DEVELOPMENT OF THE MAPPING PROCEDURE

There are no adequate surveys of the distribution of abandoned ridge and furrow or of abandoned steadings in upland Scotland. For some of the lower hill regions, including the study area, the Royal Commission for Ancient and Historical Monuments in Scotland carried out a Marginal Land Survey between 1950-56 to inventory those field monuments threatened by afforestation. The inventory is restricted, however, to pre-medieval features which severely limits its value to the present study. Of a similar nature is the collection of aerial photographs held by the Archaeological Branch of the Ordnance Survey for selected sites. Yet this includes no comprehensive survey of any part of the study area.

More relevant is a Hillfoot Survey commissioned by the East Lothian County Planning Department which located areas of felled woodland, and priority areas for planting and for reclamation in the catchment area of the northern Lammermuirs (Stephen and O'Riordan, 1962). The survey appears to have been based partly on the mapping of reverted farmland, and in this respect it should be of particular value to the present study. But it is evident that some of the landscape features have been misinterpreted. Comparison with the results of the present study suggests that the report confused abandoned cultivation ridges with other evidence for the distribution of cut-over woodland. The survey as a whole is inaccurate and unreliable, and it is not possible to derive from it any sound conclusions on the extent of land reversion or felled woodland in the area.

It is necessary, therefore, to establish a suitable method of mapping abandoned cultivation ridges and settlement sites in the study area. Emphasis is placed on the need to develop a procedure which will ensure an accurate and comprehensive survey. This is important for two reasons: first, so that a high level of confidence can be placed on the patterns found in the survey, and that some reliance may therefore be placed on explanations based on the interpretation of these patterns; secondly, so that the procedure can be tested for its applicability to the Scottish Highlands. In such an application any error in the interpretation and mapping of landscape evidence will be compounded over the large area of survey. The selection of the mapping procedure is therefore outlined in detail.

Reconnaissance survey

1. Aim and procedure

A restricted survey was undertaken to assess the practicability of the field mapping of cultivation ridges and settlement sites in moorland and on recently reclaimed land, and to estimate the quantity of these features in the study area. It was intended that the survey should evaluate the most effective approach to field mapping and assess the time required.

Six reconnaissance regions, each of 1 km^2, were selected as representative of the types of landscape found in the study area. Their choice was not random but was based on farmers' suggestions as to known locations of land and settlement desertion. Their distribution is shown in Figure 4.1.

2. Preparation for recognition of features

To ensure correct recognition of the landscape features in the field it was necessary to establish accurately their original morphology. Often this could be done by reference to recent literature. Occasionally it required study of contemporary agricultural writings and topographical descriptions. Only a summary of the conclusions is presented below.

Cultivation ridges There is no adequate analysis of the size and shape of cultivation ridges in Scotland. Birnie (1927) refers to a number of early descriptions but presents no comprehensive conclusions. The major sources of the eighteenth and early nineteenth centuries were therefore consulted in order to make a more accurate assessment of the ridge sizes likely to have been common in south-east Scotland. A summary is presented in Table 4.1. Few of the writers consulted make specific mention of average ridge width, and only four refer to their height. The conclusions must therefore be tentative.

It is evident that, before the mid-eighteenth century, most ridges were permanent features. Annual ploughing tended to gather them higher, the furrows became unploughed balks of stones and weeds, the crookedness along the length of the ridges tended to pond up surface water in the furrows (Kames, 1776: 68-74; Robertson, 1829: 197-202). In upland areas they were generally aligned directly down-slope, and averaged, on the moister soils, 220-275 m (240-300 yds) in length (Sinclair, 1812: 143). It seems that an average height was 0.9 m (3 ft), and that breadth varied from 3 m to 6 m (10-20 ft) at each end but could broaden to more than 12 m (40 ft) at the centre. The sizes of even adjacent ridges varied greatly (Dickson, 1762: 289).

Table 4.1

Dimensions of pre-improvement and post-improvement cultivation ridges

	Breadth (feet)			Height (feet)		
	Soil type: heavy	light	average	Soil type: heavy	light	average
PRE-IMPROVEMENT						
a) Advisory Sources						
Kames (1776: 70)	-	-	-	-	-	3-4
Complete Farmer (1807: 'ridging')	-	-	10-30	-	-	-
b) Descriptive Sources						
Robertson (1793:55)	-	-	36-48	-	-	3
Hepburn (1794: 51)	-	-	18-22	-	-	-
Somerville (1805: 90)	-	-	18-24	-	-	-
Sinclair (1812: 144-5)	-	-	18	-	-	-
Robertson (1829: 200)	-	-	-	-	-	3
POST-IMPROVEMENT						
a) Advisory Sources						
Kames (1776: 70, 74)	12	-	7-8	$1\frac{2}{3}$	-	$1\frac{1}{2}$
Anderson (1777: 223)	-	-	10	-	-	-
Forsyth (1804: 438)	-	-	12	-	-	$1\frac{1}{2}-1\frac{2}{3}$
Naismyth, J. (1807: 296-7)	13-15	-	c.9	-	-	-

Table 4.1 (contd)

	heavy	light	aver-age	heavy	light	aver-age
POST-IMPROVEMENT (contd)						
Complete Farmer (1807: 'ridging')	-	15-30	-	-	½ summer 1 winter	-
(Perths.)	18-21	-	-	-	-	-
	12	-	-	20	-	-
	-	-	18	-	-	-
	-	-	not>18			
Low (1838: 146)	-	-	15-18	-	-	-
Andrews (1853: 315)	-	-	18	-	-	-
Morton (1855: 645)	-	-	16½	-	-	-
b) Descriptive Sources						
Wight (1778: 210)	-	-	15	-	-	-
: 319	-	-	12	-	-	-
: 323	-	-	9	-	-	-
: 352	24	-	-	-	-	-
: 352	12-15 (advised)		-	-	-	-
Somerville (1805: 90)	-	-	9	-	-	-
Kerr (1809: 192, 223)	12½	15	-	-	-	-
Sinclair (E.Loth.)	8	30	-	-	-	-
(1812: 144-5) (Rox.)	14	-	-	-	-	-
	8-10 (advised)		-	-	-	-
Robertson (1829: 55)	-	-	10-18	-	-	-
: 210-211	9	18	18	-	-	-
c) Manuscript Sources						
Marchmont MSS (Inventory Book and Directions, 1754-63)	-	-	4½-10	-	-	-

Table 4.1 (contd)

OTHER SOURCES CONSULTED / NO DATA

Reid (1683)
Donaldson (1697)
Hamilton (1713)
MacKintosh (1729)
MacKintosh (1732)
Maxwell (1743)
Maxwell (1757)
Dickson (1762)
OSA (1791-99)
Lowe (1794)
Donaldson (1795-96)
Farmer's Magazine (1811)

Towards the end of the eighteenth century there was a widespread movement to level and straighten the ridges and to reduce their width. The recommendations made by contemporary writers are summarised in Table 4.1. The furrows were cleared of stones and the ridges tended to be 'cleaved' or 'cast' each autumn or spring so that furrows were established on the earlier crowns, and the crowns on the furrows (Robertson, 1793: 55). The breadths of the ridges varied from year to year and from area to area, but remained constant along their length and from one adjacent ridge to another.

The change from old to improved ridging took some time and varied in date from the progressive lowland farms to those in more isolated areas; consideration is given to this later (infra p.152). It is important to note, however, that much of the ridge and furrow which is a relic of pre-improvement cultivation in Scotland is likely to exhibit a marked lack of regularity, in contrast to the ridges of a similar date in lowland England. A field survey of the relict landscape must therefore recognise the occurrence of a more haphazard feature than has been generally realised, particularly where moorland vegetation and soil erosion have tended to compound its irregularity.

Settlement forms A number of studies have been made of the forms of abandoned settlement in lowland Britain (Beresford, 1951; Beresford and St Joseph, 1958; Harris, 1968; Allison, 1970; Beresford and Hurst, 1971), but few for upland areas, particularly Scotland (Fairhurst, 1971; Dunbar, 1971). A comprehensive body of information, however, is available from the more recent RCHM(S) county inventories and in archaeological journals. From these it is possible to evaluate the morphologies of abandoned settlement sites that are likely to be associated with early cultivation in south-east Scotland and which may be identified in the field.

Descriptions of each settlement form are available in the references presented below. Reliance is placed on the RCHM(S) inventories for Roxburghshire (1956) and Peeblesshire (1967) since recent and comprehensive inventories are not available for East Lothian (1924) and Berwickshire (1915).

Abandoned settlement forms known to exist in upland south-east Scotland may be summarised as follows:

Iron Age:

1. Palisaded structures (Craw, 1921; Piggott, 1951; RCHM(S), Roxburghs., 1956: 19-20)

2. Stone-walled settlements (RCHM(S), Roxburghs., 1956: 20)

3. Stone-walled homesteads (RCHM(S), Roxburghs., 1956: 20)

Roman:

4. Village settlements superimposed on ramparts of palisaded structures (RCHM(S), Roxburghs., 1956: 32)

(+ contemporary Iron Age forms)

Dark Age:

5. Brochs (Turnbull, 1879-81; Curle, 1891-2; Piggott, 1951)

6. Souterrains (RCHM(S), Roxburghs., 1956: 35)

(these occur also throughout the Scottish Iron Age)

Medieval-early eighteenth century:

7. Scooped enclosures (Stevenson, 1940-41; RCHM(S), Roxburghs., 1956: 48, 172, 177)

8. Moated homesteads (RCHM(S), Roxburghs., 1956: 47-48)

9. Farmsteads (Fenton, 1962-63; RCHM(S), Peebless., 1967: 239-43, 356-58; RCHM(S), Roxburghs., 1956: 48)

(also monastic granges, pele-houses, tower houses)

Post-improvement:

10. Farmsteads (RCHM(S), Peebless., 1967: 359-62; RCHM(S), Roxburghs., 1956: 451)

Shieling sites A field search for shieling sites can be concentrated on their characteristic locations (Gaffney, 1959). The most common relict feature of the sites is a conical mound, the remains of the turf and stone bothy. A further indicator may be the presence of modern sheep fanks, often converted from the old cattle 'rives' or folds (MacSween, 1959b). The folds varied in size from 2.5 m to 3.0 m square (8-10 ft) and the bothies from 1-2 m by 1.5-4.5 m (4-6 by 5-15 ft) (Miller, 1968).

Clearance cairns It is possible to distinguish between prehistoric and late-nineteenth century cairns simply by their size and by their association with other features. Fleming (1971) has noted that the Bronze Age cairns are usually ovoid, and measure 2.5-4.5 m (8-15 ft) by 2-3 m (6-10 ft). The more recent cairns tend to be larger, up to 9.0 m by 4.5 m (30 by 15 ft) and are often immediately uphill of mid-nineteenth century enclosures.

Enclosing dykes No modern reference has been found which relates to the traditional size of the head-dyke in southern Scotland. Its identification in the field has therefore been based on associated evidence. The patterns, shapes and sizes of post-improvement enclosing dykes are described in detail by several contemporary agricultural writers and may be more easily identified in the field (Kames, 1776: 250-67; Somerville, 1805: 82-87; Kerr, 1809: 178-88; Robertson, 1829: 61-66).

3. Problems of mapping in the field

Recognition of features in moorland Lowering of the crowns by erosion and by the trampling of sheep, and the choking of furrows with sphagnum, tend to reduce the height of cultivation ridges over periods of more than a century. A sample survey of ridge heights indicated that the greatest amplitude did not exceed 0.4 m (infra p.141). When these features are covered with 15 cm of moorland vegetation the problem of their identification is compounded. This is especially true for areas of acid grassland where a tall community of Juncaceae in the moist furrows tends to grow to the same overall height as sheep-cropped moor grass (Molinia caerulea) and common bent (Agrostis tenuis) on the crowns. It is thus evident that when surveyed in the field, the pattern of ridges can seldom be identified on moorland by its morphology alone, particularly when it is viewed at right angles to its orientation.

The vegetation patterns attendant upon variations in soil moisture and acidity from ridge to furrow are useful indicators, but these patterns are difficult to distinguish at the medium scale; that is, they require either close investigation to ascertain the different plant types, or distant observation to evaluate broad differences in texture which are not apparent close at hand. The most satisfactory method of mapping was thus found to be from vantage points with wide views of landscape features on opposite valley sides. The difficulties of achieving this form of observation for the whole moorland area are obvious.

Similar difficulties prevail over the field survey of settlement sites in moorland. The robbing of stone for the construction of dykes or sheep fanks, the trampling by sheep and the frequent demolition of derelict steadings on the moor to remove shelter for vagrants, contributes to the surprisingly rapid disappearance of deserted buildings. This is increased by the action of soil fauna in the gradual lowering of upstanding structures despite the fact that there is generally a lower level of soil fauna activity in acid upland soils than in more basic lowland ones (Atkinson, 1957). Thus many large stone steadings marked on early maps of the Ordnance Survey as inhabited in the 1850s but abandoned by the 1890s may leave little on the present landscape to identify their site. They may be picked out by patterns of vegetation (infra p. 86) but again there is the difficulty of distance in recognition.

Before the mid-eighteenth century it was common for smaller dwellings to have been constructed of interlaid turf and stone, which would soon disintegrate without regular repair (Fenton, 1968). The same is true for the shieling bothy and the head-dyke. Unlike the Highlands where their date of abandonment is much more recent, there is often no visible morphological relic of these features in the study area. The vegetation pattern is the only legacy.

Recognition of features on recently improved land Outside the moorland core, where the land has been under recent, sometimes only brief cultivation, the relict features have often been artificially levelled or have been gradually lowered by regular ploughing. In these areas, apart from the use of vegetation indicators in reverting grassland, there is little to help field observation.

It is therefore often impossible to map the traces of relict landscape features in recently cultivated land. In the moorland core they may be mapped by distant observation when the sun is low on the horizon, but it is unlikely that all features will appear under even these conditions. Field mapping thus cannot offer a method that is sufficiently comprehensive for recording the location of former limits of cultivation. The need for long-range observation of broad textural patterns of ridge and furrow suggests the use of aerial photography.

Aerial photographs and the mapping of abandoned land

The literature

The value of the interpretation of aerial photographs to archaeological studies has long been appreciated and early use was made of aerial survey in the search for and analysis of features of the relict landscape (Crawford, 1923, 1939; Curwen, 1938). However, the interpretation on which this mapping was based appears to have been as much intuitive as systematic. This is less important in the aerial survey of specific and known sites, the main archaeological use of aerial photography. But for the comprehensive mapping of particular features over a large area, an intuitive procedure can lead to an incorrect result which is the product of the compounded bias of initially small errors of interpretation. The alternative 'trial and error' approach can be lengthy and expensive.

Moreover, unsystematic approaches are of only temporary value to the study for which they were developed. This procedure is neither logical nor tested, and it may not readily be applied to other areas and to other, but similar, landscape features. Consequently the systematic use of aerial photographs in archaeology and agricultural history has suffered from a lack of accepted guidelines to interpretation. This is in contrast to the mapping of contemporary land use from aerial photographs (Dill, 1959; Boesch and Steiner, 1959; Colwell, 1965; Brenchley, 1968).

In the present study the need both for a high degree of comprehensiveness in mapping and for a procedure which may be applicable elsewhere in upland Scotland requires a systematic approach to the interpretation of aerial photographs. For this reason brief consideration will be given to the relevant literature in an attempt to incorporate previous experience in the aerial survey of abandoned land. Following this, an outline is presented of a reconnaissance survey aimed at assessing the possibility of mapping abandoned land from aerial photographs and at establishing the requirements of an aerial survey. The final sections deal with the setting up of interpretation keys to systematise the photo-reading, the field checking of interpretation, and the evaluation of accuracy.

The use of aerial photography in the study of genesis and change of the rural landscape has received close attention outside Britain. Haefner (1967) has noted that most of the recent progress in this field has been made in the universities at Lund, Gent, Bonn, Paris and Zurich, where increasing emphasis is placed on holistic interpretations of the landscape milieu (Guy, 1962; Chevallier, 1964; Snacken, 1964; Schmidt-Kraepelin, 1964). Here there has been an attempt not only to rationalise interpretation procedure _vis a vis_ agrarian history but to incorporate information from related studies particularly of manuscript maps and of landforms (Mazars and Cabaussel, 1964; Lapeyre, 1964; Snacken, 1964). The most recent work along these lines is summarised in the Proceedings of the Toulouse Conference on Aerial Surveys and Integrated Studies

(UNESCO, 1968). In the present study an attempt is made to base the survey procedure on the experience and principles developed in Europe over the last decade.

In Great Britain there has been little attempt to develop a coherent body of experience in the interpretation and analysis of landscape change; this seems to have been rejected in favour of empirical studies of specific features or regions. Most of these studies have been located in lowland areas, with a vegetation cover often of ley or permanent grass. This is particularly true of aerial surveys of ridge and furrow (Mead, 1954 et al), and of deserted medieval settlements (Beresford, 1951 et al). Moreover, most of the studies of settlement sites have been of hamlets or villages rather than of clachans or farmsteads. This is true also of European work (Sensenbremmer, 1969). There is, thus, an unfortunate gap in our knowledge of techniques of interpretation from aerial photographs for moorland landscapes and farmstead sites.

Many of the aerial surveys of moorland areas have concentrated on a search for prehistoric and Roman field monuments. Crawford (1939) and St Joseph (1949) have published results of surveys which have located Iron Age forts in the study area. Early field systems have been mapped from aerial photographs by Fox (1954) for Dartmoor and by Jeannson (1963) for heath areas in Denmark. Most of St Joseph's reconnaissance surveys which have covered parts of the study area have been concerned only with Roman features, particularly the temporary forts along Dere Street (St Joseph, 1951, 1955, 1958, 1961, 1969).

There are few references to the use of aerial photography in the survey of medieval or post-medieval moorland landscapes in Great Britain. Crawford (1939) and Graham (1939) have discussed the distribution of cultivation terraces in southern Scotland, but only Beresford and St Joseph (1958: 91) have used aerial photographs to construct a chronology of upland reclamation.

The mapping of abandoned farmsteads in upland Britain has, however, been more widespread. The recent county inventories of the RCHM(S) include maps of medieval and seventeenth century homestead sites. But although Steer (1947), who carried out some of the mapping for the Roxburghshire inventory (1956), envisaged the illustration of future archaeological reports by annotated stereo-pairs, the interpretation procedures were not published.

In Europe, however, there have been more recent and more comprehensive studies made by aerial survey of former cultivation limits. Lefebvre (1969) has analysed trends in land reclamation in Brie from the twelfth to the eighteenth century. Aldskogius (1960) and Flavinet (1969) have studied the recent abandonment of land on steep slopes and in upland areas. Yet the only systematic interpretation of medieval ridge and furrow in moorland, apart from passing references in the most recent RCHM(S) inventories, has been by Jeannson (1961) in southern Sweden. However, the information from a variety of these European surveys has been valuable in the construction of interpretation keys for the study area (infra pp. 83-7).

An attempt was thus made to incorporate the relevant experience of aerial mapping in moorland areas into the development of an adequate survey method. This has reduced the likelihood of substantial errors being made during the interpretation of aerial photographs. Consideration is now given to the viability of an aerial survey under conditions prevailing in the study area.

Reconnaissance survey with aerial photographs

A reconnaissance of the study area was made in order to:

1. establish whether abandoned cultivation ridges, settlement sites and other relict features, both in moorland and in improved land, could be mapped comprehensively and accurately from aerial photographs;

2. select the most suitable procedure if an aerial survey was judged to be satisfactory;

3. ascertain the photographic requirements of the project;

4. assess the time and cost of the project.

Six reconnaissance areas, each of 5 km^2, were selected to correspond with the smaller field reconnaissance areas. Six further areas were selected to include other types of landform and moorland vegetation not represented by the earlier field checks. Their location is shown on Figure 4.1. Photographs were also studied for 5 km^2 blocks in the Pentland Hills (GR 1355), the Ochil Hills (GR NO 0410), and the West Water Valley in Angus (GR NO 5266). The purpose of establishing these check areas elsewhere was to ensure that the criteria of interpretation were not restricted to patterns unique to the study area.

Procedure For each reconnaissance area a variety of available photographic cover was obtained. This included oblique, panchromatic (J.K. St Joseph, RCHM(S)); split-vertical, panchromatic and infra-red (R.A.F., Scottish Development Department); and vertical, panchromatic

(Ordnance Survey). These are discussed in detail later (infra p. 79). Relict features were identified and mapped from each coverage on the basis of:

1. the procedures recommended by the literature reviewed above;

2. the principles of convergence of evidence from the six universal interpretation criteria (American Society of Photogrammetry, 1960: 100) and from the four additional interpretation criteria of air archaeology (Bradford, 1957: 11-41; American Society of Photogrammetry, 1960: 725-32);

3. the progress of interpretation from the general to the particular, from the known to the unknown;

4. the search for abnormality in the semi-natural moorland landscape (Soyer, 1966).

The completed interpretation for each block was checked in the field and re-interpreted in the light of field observation.

<u>Viability</u> It was concluded that ridge patterns could be mapped comprehensively from aerial photographs only if either high quality, large-scale prints or an adequate duplicate coverage was available. In either case the interpretation would require blanket field checking. Interpretation was possible from linear vegetation patterns resulting from differences in soil moisture, though rarely from the shadows thrown by the ridges.

The mapping of settlement and shieling sites was unlikely to be complete unless large-scale photography was available. Clearance cairns, and both early and post-improvement dykes were generally identifiable at the scales of coverage commonly available and with thorough ground checking.

Airphoto requirements

1. Filters and film Infra-red photography is particularly useful in the identification of abandoned cultivation ridges. Owing to continued differences in drainage between ridge and furrow, the moist furrows are registered as dark tones on the photo image. Identification of vegetation patterns is less simple, however, since the criteria for infra-red interpretation have not been established for moorland vegetation. It was found that panchromatic film with a minus-blue filter was most suitable.

2. Scale Scales of 1:10,000 or less are generally adequate for the identification of cultivation ridges but are too small to permit the recognition of settlement sites. Crawford and Keiller (Steer, 1947) note that scales not smaller than 1:6,000 provide the best results for large field monuments. The reconnaissance survey suggests that this would also be adequate for the minor features.

Cost and time in mapping are, of course, related to the scale of the photographs.

3. Image quality Sharpness of image is important for the reproduction of fine tonal and textural differences in the vegetation pattern.

4. Date Soil, crop and natural vegetation patterns are generally enhanced during droughts. In dry summers it is apparent that vegetational differences between crown and furrow are exaggerated, on dry uplands the growth of Deschampsia on the crowns being more retarded than that of Molinia-Nardus in the moisture-retaining furrows. On improved land the appearance of crop- or soil-marks is similarly heightened in dry seasons.

5. Seasonality Seasonal changes, particularly in the growth rate of crops and natural vegetation, have a significant influence on the aerial appearance of the landscape (Boesch and Brunnschweiler, D., 1960; Goguey, 1966). Indeed, the reconnaissance survey indicated that seasonal differences of growth among moorland plants in the study area can substantially alter the appearance of abandoned cultivation ridges. Thus, at the onset of the growing season, the light green grasses in the furrows and the heather on the crowns produce a marked tonal contrast in dry moorland areas. Moreover, where abandoned cultivation or settlement sites are differentiated by Festuca and Agrostis from surrounding Nardus-Molinia or heather areas, the earlier onset of growth of the shorter grasses contrasts with the still dun-coloured environment. This is reproduced as tonal contrast on the photo image. Steiner (1966) has noted a similar contrast between improved and unimproved alpine meadows from May until June.

In high summer tonal differences due to vegetation are generally reduced, but increase again in the early autumn with the browning of bracken, Nardus and Molinia which again allows easier differentiation from Festuca and Agrostis. This seasonal change is small, however, in comparison to the perennial contrast between heather and other vegetation in the study area.

Tonal differences in vegetation are least in winter, but light or melting snow and hoar frost provide the most vivid contrast on photographs for almost every landscape feature. The linear pattern of abandoned cultivation ridges is often striking, and field checking under these conditions is particularly valuable.

6. Time of day Longer shadows in autumn or late summer evenings offer the advantage of marked tonal differences.

The available coverage of aerial photographs

Two complete coverages of aerial photographs are available for the study area: that flown by the Royal Air Force in 1946-59 and now held by the Scottish Development Department in Edinburgh, and that commissioned by the Ordnance Survey and retained in Southampton. Scattered obliques and verticals are held by J.K. St Joseph (University of Cambridge), by Meridian Airmaps Ltd (Lancing) and by B.U.S. Surveys Ltd (Leatherhead). These do not provide a complete cover, however, and are unsatisfactory for comprehensive mapping.

Specifications of the Royal Air Force and Ordnance Survey photography may be summarised as follows:

Ordnance Survey:

	type:	all vertical, panchromatic minus-blue
	size:	23 x 23 cm contact prints
i)	scale:	1:7,000-1:7,500
	coverage:	north half of the study area (Fig. 4.2)
	date:	1962 and 1965, 'high' summer
ii)	scale:	1:25,000
	coverage:	Fala and Channelkirk areas only (Fig. 4.2)
	date:	1955 and 1957, 'high' summer
	quality:	excellent

Royal Air Force:

type:	mostly split verticals, panchromatic minus-blue; some verticals; some infra-red (Fig. 4.3)
size:	20 x 18 cm contact prints
scale:	approx. 1:10,000
coverage:	shown in Fig. 4.4
date:	April, May, June 1946; August 1946; October 1959
quality:	variable, moderate to poor

The extent of duplicate and triplicate coverage and the distribution of seasonal differences in the R.A.F. coverage are illustrated in Figures 4.3 and 4.4.

The choice The quality and scale of Ordnance Survey photography of the study area is satisfactory for the identification of most relict features. The incompleteness of the coverage, however, greatly decreases its value. Moreover, patterns of vegetation are not so marked at the time of the year at which this cover was flown and the summers of 1955, 1957, 1962, 1965 are not recorded as abnormally dry for south-east Scotland. Finally, photographs may not be borrowed from the Ordnance Survey. They may be studied at Southampton but this prohibits concurrent interpretation and field checking. The cost of purchasing the cover for the study area was estimated at £300.

The quality of the R.A.F. cover is generally far inferior to that of the Ordnance Survey, although the scale is adequate for the recognition of most relict features. This disadvantage is compensated, however, by the availability of duplicate and triplicate coverages flown at different seasons of the year (Figs. 4.3 and 4.4). Because seasonal changes in moorland vegetation are evidently great a duplicate photograph for a different season often exhibits a different image. It became evident during the mapping of the study area that ridge and furrow frequently appeared on some air photographs but not on others. This effect was ascribed to seasonal change.

The need for a duplicate coverage was increased by the inadequacy of much of the ground checking owing to the difficulties of recognising relict features in the field.

The majority of the R.A.F. cover was flown in spring and autumn (Fig. 4.4) when tonal differences in vegetation are greatest. Moreover, much of it was flown after the exceptionally dry summers of 1947 and 1959, and during the spring of 1946 which is recorded as having been warm, dry and sunny in eastern Scotland (Meteorological Office, 1947).

Finally, it should be mentioned that until October 1969 R.A.F. photographs held by the Scottish Development Department were available on loan. This enabled concurrent interpretation and field checking.

Conclusion The R.A.F. coverage was therefore chosen for the survey of the study area. A primary coverage of higher quality photography was selected for the initial mapping, which was checked by reference to a duplicate coverage of lower quality. It was assumed that one quarter of the study area would require the study of duplicate photographs to confirm doubtful primary interpretation. The number of photographs requiring study thus totalled 1400, while the reconnaissance survey suggested a mapping rate of ten prints (or 10 km^2) per day, including field checking. The time expected to be taken over the mapping project was thus estimated at six months. Alterations to the estimate had to be made in view of a later need to study all, rather than a quarter of the duplicates, and to evaluate the accuracy of the survey by a field traverse (infra p.89).

THE MAPPING PROCEDURE

Establishing the criteria for interpretation

The initial mapping of three 100 km^2 blocks of the study area was checked in the field immediately following the interpretation. Aerial photographs were chosen so that field patterns could be confirmed in the same season as the photographs were taken. On the basis of this interpretation and field checking, interpretation keys were constructed for the main features to be mapped. These keys reduced errors in intuitive interpretation and obviated the need for continued concurrent field checking. They may be valuable as a basis for future work elsewhere in upland Scotland.

Two examples of interpretation from aerial photographs are illustrated in Figures 4.6 and 4.7. They represent areas of exceptionally pronounced ridge patterns which are easily visible on single prints. The fainter patterns characteristic of most of the study area would require illustration by stereo-pairs to enable the features to be clearly seen. The annotated overlays and accompanying notes are designed to illustrate the appearance of different features under a variety of vegetation cover.

From the procedure illustrated in Figures 4.6 and 4.7 interpretation keys were established for cultivation ridges, settlement sites and enclosure features. These are essentially descriptive notes on each criterion of recognition, in contrast to dichotomous two-branched keys which are more valuable in the interpretation of the entire landscape (American Society of Photogrammetry, 1960: 556-57). In the present survey interpretation is made only of selected and areally limited features.

Interpretation keys

A. CULTIVATION RIDGES

1. GREY TONES

a) Due to natural or semi-natural vegetation

	ridge		furrow	
	Light tone	Dark tone	Light tone	Dark tone
i) in moorland				
i.a) on well-drained but acid soils				
1.	Agrostis tenuis	-	-	Molinia, Juncus spp.
2.	-	Calluna vulgaris	Nardus	-
3.	-	Calluna vulgaris/ Deschampsia flexuosa	Nardus/ Deschampsia flexuosa	-
4.	-	Calluna vulgaris/ Nardus	Molinia/ Nardus	
i.b) on well-drained less acid soils				
5.	Pteridium	-	-	Molinia/ Deschampsia flexuosa
6.	Festuca ovina	-	-	Molinia/ Nardus
7.	Anthoxanthum odoratum/ Deschampsia flexuosa	-	-	Molinia/ Nardus
i.c) on poorly drained soils				
8.	Molinia	-	-	Molinia/ Juncus spp./ Sphagnum

9. Molinia	-	-	Eriophorum/ Sphagnum
10. Nardus/ Molinia	-	-	Molinia/ Eriophorum/ Sphagnum
11. Eriophorum	-	-	Juncus/ Sphagnum

ii) <u>in reverting grassland</u>:

1. Festuca ovina	-	-	Festuca ovina/ Juncus spp.
2. -	Pteridium	-	sown grasses/ Deschampsia cespitosa
3. sown grasses/ Deschampsia cespitosa	-	-	Deschampsia cespitosa/ Juncus spp.

b) <u>Due to crop marks</u>

darker furrows (taller crop growth)

c) <u>Due to soil marks</u>

darker furrows (greater soil moisture)

2. TEXTURE

ridges: coarser texture on dry uplands (Calluna, Pteridium, Ulex)

furrows: coarser texture on wet uplands and in reverting grassland (Juncaceae)

3. SHADOWS

Linear shadow patterns only where:

a) low vegetation cover (viz., unlevelled ridges in reverting pasture)

b) old heather on ridges.

4. LOCATION

almost universal orientation down-slope (cf. open drains normally cross-slope)

normally not located on slopes less than 2^{o} or more than 10^{o}; limit of abandoned cultivation often determined by break of slope.

5. ASSOCIATED FEATURES

proximity to edge of 'moorland core'.

proximity to abandoned settlement sites, old roads.

vegetation indicators of soil fertility (Pteridium, Carduus spp., Cirsium spp.)

6. SHAPE

<u>either</u> a) curved in slight reversed-S; irregular in breadth and length; sometimes with a secondary ridge of stones along furrow centre.

<u>or</u> b) straight; regular breadth and length; sometimes alternate subsidiary furrows on ridge crest.

7. DIMENSION

a) <u>Breadth</u>

i) If curved and of irregular breadth and length, then:
7.0-14.0 m, normally 8.0-12.0 m;
ridge-furrow ratio about 2:1.

ii) If straight and of regular breadth and length, then:
<u>either</u> 3.0-5.0 m; ridge-furrow ratio about 3:1-5:1.
<u>or</u> 7.0-10.0 m; ridge-furrow ratio about 6:1-8:1.

b) <u>Amplitude</u>

i) If a.i, then:
nil to max. 0.5 m

ii) If a.ii, then:
nil to max. 0.2 m

c) <u>Length</u> variable, not diagnostic.

Note: confusion with forest ploughing and open drains can be avoided by attention to the spacing and amplitude of these features:

ploughing for afforestation: standard spacing of 1.5-2.0 m (Henman, 1963: 11); depth 15-30 cm (Zehetmayr, 1960: 41).

open sheep-drains: spacing variable, 30-60 m, depth 15-30 cm.

Thus a four-fold typology of cultivation ridges has been proposed:

1. broad, irregular
2. narrow, regular
3. broad, regular
4. superimposed

The cross-sections of these types are illustrated in Figure 4.5. The typology is designed to ensure recognition of the variable appearance of abandoned ridges. It is not based on rigorous measurement. Its validity as a functional or chronological classification is later tested by measurement in the field to assess its value as a dating technique (infra pp.136-42).

B. SETTLEMENT SITES

1. GREY TONES

a) Due to natural or semi-natural vegetation

i) on dry sites

light tones (Deschampsia flexuosa, Festuca ovina, Anthoxanthum) in contrast to Calluna and Nardus.

ii) on wet sites

light tones (Deschampsia flexuosa, Nardus) in contrast to Molinia, Eriophorum.

lighter tones also due to closer cropping by sheep of grasses on settlement sites.

b) Due to crop marks

no diagnostic tones since traces removed by levelling for cultivation.

c) Due to soil marks

light tones.

2. TEXTURE

a) within moorland core:

smoother texture of short grasses in contrast to coarse Calluna, Nardus, etc.

b) on reverting pasture:

coarser texture of Pteridium, Carduum spp. and Cirsium spp.

3. SHADOWS

rarely useful

4. LOCATION

common location at upper edge of contemporary cultivation.

5. ASSOCIATED FEATURES

proximity to cultivation ridges, dykes, roads.

6. SHAPE, and

See discussion and references above

7. DIMENSION

C. ENCLOSURE FEATURES

characteristics of tone, texture, shadows, associated features similar to those of settlement sites.

SHAPE and DIMENSION: see discussion and references above

Procedure

Cultivation ridges in the moorland core

Abandoned cultivation ridges were identified from aerial photographs on the basis of the established criteria for interpretation from a primary coverage of 1,100 prints. This interpretation and the field checking of uncertain sites proceeded at an average rate of ten prints per day. The location and extent of areas exhibiting cultivation ridges were mapped on nineteen 1:25,000 O.S. sheets and noted on index cards.

From this initial interpretation 276 plots totalling 4,213 ha of abandoned land were mapped within the moorland core of the study area. For these plots the analysis of the aerial photographs and occasional checking in the field suggested positive and certain evidence. However, for a further 147 plots, totalling 1,919 ha, traces of ridges were identified on photographs while evidence in the field was inconclusive. Thus 31 per cent of the photographic interpretation remained unconfirmed. The distribution of the uncertain sites is shown in Figure 4.8. Most of them are located on the central and higher areas where soil erosion, over-burning of heather and the complexity of moorland vegetation combine to confuse the appearance of cultivation ridges. It is therefore evident that both the quantity of unconfirmed interpretation and the distribution of uncertain sites seriously reduce the value of mapping.

Duplicate coverage A duplicate coverage of aerial photographs comprising a further 800 prints was analysed in an attempt to reduce the number of these sites. On 124 plots (1,208 ha) the initial interpretation was found to have been incorrect. Fifteen plots (594 ha) were positively confirmed as exhibiting cultivation ridges. On the remaining eight sites (117 ha) the uncertainty of the evidence was unresolved (Fig. 4.8).

The study of the duplicate coverage revealed one area of about 41 ha which had been overlooked in the initial mapping (Fig. 4.8).

Field survey A second check was made in the field of the remaining unconfirmed sites, comprising the study of natural soil profiles where they existed or auger borings where they did not. Five sites (34 ha) exhibited either shallow mineral horizons below contemporary surface roots or evidence of the collection of stones into lines. The remaining three sites (83 ha) exhibited no evidence of early cultivation. The distribution of these sites is illustrated in Figure 4.8.

Accuracy of the mapping The completeness of the mapping was checked by traversing the study area on foot in conditions which particularly favour the appearance of cultivation ridges, for example on bright late summer evenings when long shadows are cast by the smallest irregularities, and on the occasions of light or melting snow.

A network of these traverses revealed only one site of 6 ha which had been overlooked on the initial and duplicate surveys (Fig. 4.8). This suggests that almost all the landscape evidence that is extant is exhibited on and was identified from the aerial photographs. Yet the proportion of the total evidence that has been overlooked in the survey cannot be accurately assessed; but it is suggested that the mapping of cultivation ridges in moorland for the study area is accurate to within ±250 ha (or ±5.0 per cent). It is probable that an intuitive approach to the airphoto interpretation of the evidence would not have yielded as high a level of accuracy.

Cultivation ridges on marginal land

Evidence of curved, irregular cultivation ridges outside the moorland core was noted on index cards and on 1:25,000 maps. The occurrence of this evidence is sparse. Signs of pre-improvement ridging at locations likely to have been at the limit of pre-improvement cultivation were apparent at only 26 sites. Moreover, the study of duplicate photographs and a field survey revealed no other sites. Over most marginal farmland the early ridges have been replaced by low and straight ones or have been erased by more recent tillage. It is not possible to assess the accuracy of the survey; certainly no firm conclusions may be interpreted from these results alone.

Settlement sites

The locations of deserted settlement sites both within and without the moorland core, unmarked on the Ordnance Survey map sequence, were identified on the aerial photographs. Several were not apparent on the primary coverage but were identified from the study of duplicates. The field traverses revealed no further sites.

All sites were visited in the field. Sixteen were confirmed from their morphology as having included permanent dwellings but a further 30 could not be located with certainty. The difficulties of recognising ill-defined settlement sites in the field has, however, been previously noted and the lack of confirmation in the field does not disprove their former existence .

The inadequacy of the ground checking and problems of interpretation militate against a comprehensive survey of settlement sites from aerial photographs. An evaluation of the accuracy of this mapping is made in the following chapter.

Associated features

Evidence of head-dykes, shieling sites, post-improvement dykes and hill tracks was noted on 1:25,000 maps. All features were checked in the field and, where possible, on a duplicate coverage of photographs. Yet none but the mapping of post-improvement features can be considered comprehensive.

THE RESULTS

It is evident that only the mapping of abandoned land within the moorland core is sufficiently complete to justify analysis of its distribution *per se*. The interpretation of other features was included as a subsidiary study which provides supporting but not primary evidence for the dating and location of former limits of cultivation.

Cultivation ridges in the moorland core

Some 11.1 per cent (4,890 ha) of the moorland core exhibits evidence of early cultivation. Since by definition the moorland core is that area which has lain unimproved since the mid-nineteenth century, the suggestion is that more than one-tenth of it had been reclaimed for cultivation but reverted to rough pasture before 1860. Figure 4.9 reveals the location and quantity of this abandoned land. There appear to be three zones of concentration.

About 25 per cent (1,250 ha) of the abandonment occurs on the less steep slopes of the valleys of the Whiteadder, Bothwell and Monynut waters. Some extends on to the Lammermuir plateau more than 75 m above the limits of the 1860-1970 moorland core. A further concentration of about 700 ha (14 per cent) is located on the upper edge of the 'higher lowland' peneplain flanking the Dye and Watch Waters, while the third is centred on the upper Merse at 180-245 m O.D.

There is an even but narrow zone of fluctuation along the northern escarpment, but its extent has clearly been limited by restraints of slope and by thin, erodible soils. Along the southern slopes of the moorland core, particularly in the sheltered parts of Lauderdale, past cultivation has reached up to 470 m O.D.

Specific consideration is given in a later section to the distribution of abandoned land at various dates (infra p.179). However, of especial relevance to the present context is the quantity of early tillage located far above the recorded limits of cultivation and well toward the centre of the moorland core. The suggestion is that before 1860 cultivation extended into areas that are now regarded as 'permanent' moor, and that the quantity of moorland that was once cultivated is surprisingly large.

Cultivation ridges on marginal land

The patterns of abandoned land illustrated in Figure 4.9 are partly a function of the location of the 1860-1970 moorland core. For example, the widespread reclamation in the Stow Uplands in the late nineteenth century advanced in several areas beyond earlier limits of cultivation (supra p.34). Many of the older cultivation ridges were erased in the process, so that the early limits of cultivation are obscured in areas of farmland.

However, while the landscape evidence for early limits of cultivation outside the moorland core is unsatisfactory, it is possible to interpolate possible limits to pre-improvement tillage between sites of confirmed irregular cultivation ridges. The interpolation is based on breaks of slope, on field and parish boundaries and on the limits of cultivation recorded on the first edition of Ordnance Survey maps. Yet, since this is only a tentative reconstruction from landscape evidence alone the presentation will await comparison with evidence from large-scale county maps (infra p.181).

Settlement sites

Figure 4.10 illustrates the distribution of 46 hitherto unrecorded settlement sites in the study area, of which sixteen have been confirmed in the field. The correlation of their location with that of abandoned cultivation may be noted: fourteen of the confirmed sites are located within or at the periphery of areas exhibiting cultivation ridges. The suggestion is that the settlements were contemporary with the early cultivation. A more detailed discussion of these and other settlement sites is presented in the following chapter.

CONCLUSION

It is evident that abandoned cultivation ridges are a comprehensive indicator of the location of early limits of cultivation within the moorland core. Their value, however, depends on the achievement of a high degree of accuracy in their identification and mapping. A systematic procedure for their interpretation from aerial photographs, which may be applied to other areas of upland Scotland, was therefore established. A tentative estimate has placed the accuracy of the mapping of the study area at a 95 per cent level of confidence.

Over ten per cent of the moorland core of the study area has been found to exhibit evidence of unrecorded early cultivation. This land was reclaimed and abandoned before 1860 since when it has lain as unimproved moorland. The quantity of abandoned land and its location well within the moorland core indicate that the limit of cultivation once far exceeded the maximum extent recorded by the Ordnance Survey over the last century.

It is not known, however, if this abandoned land is the product of tillage of one particular period, thus representing a single extreme limit of cultivation, or of a number of irregular periods of reclamation which do not reflect widespread change in the synoptic limit of cultivation. Moreover it is not known whether the tillage was ephemeral or of long standing.

It is therefore important, first, to establish the relative dates of cultivation within the moorland core in order to evaluate whether the abandoned land represents discrete trends of movement of the limit of cultivation, or whether it is merely the legacy of piecemeal reclamation at widely spaced periods of time. This question is discussed in Part III. Secondly, it is necessary to assess whether it is the relic of long-term agriculture and settlement, or of ephemeral catch cropping.

The degree of permanence of the early cultivation may be studied with reference to associated settlements. Figure 4.10 has shown a marked association between abandoned steadings and abandoned land that suggests long-term agriculture. The evidence, however, is unconvincing. In the following chapter, therefore, consideration is given to the mapping of abandoned steadings from a sequence of large-scale county maps. This aims, first, to explore more fully the relationship between abandoned land and abandoned settlement in order to ascertain the degree of permanence of the early cultivation; secondly, if this relationship is confirmed, it aims to provide a means by which the abandoned land may be dated.

CHAPTER 5

MAPPING FROM A SEQUENCE OF COUNTY MAPS

In this chapter consideration is given to the evidence for the location of former limits of cultivation on a number of large-scale county maps of the study area. Analysis is made of these maps in an attempt to:

1. reconstruct in greater detail the location of the pre-Ordnance Survey limit of cultivation;

2. evaluate the degree of permanence of abandoned cultivation located within the moorland core;

3. provide a framework for dating the reclamation and abandonment of the land within the moorland core.

Most of the cartographic evidence which is relevant to the study lies in the distribution of rural settlement. An attempt is made to extract from a selected sequence of maps trends in settlement establishment and abandonment. The location of these settlements may corroborate the evidence for abandoned land derived from aerial photographs. Any spatial correlation between settlement sites and abandoned land may point to the permanence of former cultivation and may allow the dating of its reclamation and abandonment.

THE MAP COVERAGE

The coverage of early maps of the study area at scales larger than 1:200,000 is listed in Table 5.1. Originals or copies of these are held

Table 5.1

Large-scale county maps of south-east Scotland

pub'n date	author	engraver (or MS)	title*	scale
EAST LOTHIAN				
1610	Pont, T.	Hondius, J.	A New Description of the Shyres of Lothian and Linlitquo.	1:101,376
1631	Pont, T.	Hondius, J.	The Shyres of Lothian and Linlitquo.	1:101,376
1654	Pont, T.	Jansson, J.	Provincae Lauden seu Lothien et Linlitquo.	1:101,376
1654	Blaeu, J.	Blaeu, Atlas Novus	Lothian and Linlitquo.	1:152,064
1682	Adair, J.	MS	East Lothian (A.10, NLS)	1:76,032
c.1736	Adair, J.	Cooper, R.	Map of East Lothian	1:76,032
1744	Elphinstone, J. Master of	Smith, T.	Map of the Lothians	1:126,720
1745	Millar, A.	Kitchin, T.	Complete and Exact Map of the Lothians	1:126,720
1745	Adair, J.	Cooper, R.	The Lothians	1:50,688
1773	Armstrong, Capt. A. & M.J.	Kitchin, T.	Map of the Three Lothians	1:63,360

* NLS reference if MS

Table 5.1 (contd)

pub'n date	author	engraver (or MS)	title	scale
1801	Forrest, W.	Kirkwood and Sons	Haddingtonshire	1:31,680
1822	Thomson's Atlas, Map No.2	Neele, S.J. and Son	Haddington	1:67,584
1825	Sharp, Greenwood and Fowler	Dower, J.	County of Haddington	1:63,360
1845	Fowler, of East Lothian	Johnston, W. and A.K.	Plan of the County of East Lothian	1:63,360
BERWICKSHIRE				
c.1654	Gordon, R.	MS	A Description of the Province of Merche (G.58, NLS)	1:147,480
1654	Blaeu, J.	Blaeu, Atlas Novus	The Merce or Shirrefdome of Berwick	1:84,480
1654	Blaeu, J.	Blaeu, Atlas Novus	Lauderdalia	1:50,688
1771	Armstrong, Capt. A. and M.J.	Bell, A.	County of Berwick	1:63,360
1772	Armstrong, Capt. A. and M.J.	Gavin, H.	Berwickshire	1:126,720
1797	Blackadder, J.	Ainslie, J.	Berwickshire	1:63,360

Table 5.1 (contd)

pub'n date	author	engraver (or MS)	title	scale
1821	Thomson's Atlas, Map No.3	Neele, S.J.	Berwickshire	1:92,160
1826	Sharp, Greenwood and Fowler	Dower, J.	County of Berwick	1:63,360
MIDLOTHIAN				
1610	Pont (supra)			
1631	Pont (supra)			
1646	Pont (supra)			
1646	Blaeu (supra)			
c.1680	Adair, J.	MS	Map of Mid-lothian (A.9, NLS)	1:63,360
1735	Adair, J.	Cooper, R.	Map of Mid-lothian	1:50,688
1763	Laurie, J.	Baillie, A.	Map of the County of Midlothian	1:33,347
1773	Armstrong, Capt. A. and M.J.	(supra)		
1777	Ainslie, J.		Map of the Country around Edinburgh	1:253,440
1816	Knox, J.	Neele, S.J.	Shire of Edinburgh	1:42,240

Table 5.1 (contd)

pub'n date	author	engraver (or MS)	title	scale
1821-2	Thomson's Atlas, Map No.1	Neele, S.J. and another	Edinburghshire	1:42,240
1828	Sharp, Greenwood and Fowler	Dower, J.	County of Edinburgh	1:63,360
1842	Johnston, W. and A.K.	Dower, J. and Johnston, W. and A.K.	Edinburgh-Midlothian	1:63,360
1845	Fowler, W.	Johnston, W. and A.K.	County of Edinburgh	1:63,360
ROXBURGH (Melrose parish only)				
c.1654	Gordon, R.	MS	The Sherifdome of Etricke Forest with adjoining provinces (G.57, NLS)	1:300,960
1654	Blaeu, J.	Blaeu, Atlas Novus	Twee-dail with Selkirk	1:101,376
c.1680	Adair, J.	MS	The Sherifdome of Etrick Forest (A.12, NLS)	1:72,411
1770	Stobie, M.	Bayly, J.	Roxburghshire	1:63,360
1822	Thomson's Atlas, Map No.4	Hewitt, N.R.	Roxburghshire	1:101,376
1838	Tennant, N.	Johnston, W.	County of Roxburgh	1:42,240

in the National Library of Scotland (NLS). Surveys on a smaller scale and of the whole of Scotland, such as those by Dorret (1750), Ainslie (1789) and Arrowsmith (1807), are not included. The Military Survey of Scotland (1:36,000, 1747-55) is the only national map of sufficient detail to warrant examination.

EVIDENCE OF FORMER LIMITS OF CULTIVATION: THE MILITARY SURVEY, 1747-55

All the county maps extant for the study area illustrate the distribution of settlement and estate policies with a variety of accuracy and detail. The only uses of land that are recorded by these, however, are woodland and parkland, which are valuable indicators of the limits of enclosed land. Reference is later made to them in a discussion of the upward extension of enclosure in the late eighteenth and early nineteenth centuries (infra p.152). On the limits of unenclosed land, however, which comprised the greater proportion of the marginal arable before 1800, the maps provide little information.

Small-scale agricultural maps were produced for most of the counties of Scotland, including those accompanying the Board of Agriculture reports at the turn of the century (Robertson, 1795; Douglas, 1798; Somerville, 1805; Kerr, 1809). But none of these illustrates the distribution of improved land.

The only pre-Ordnance Survey map which refers to the location of cultivation is the manuscript Military Survey of Scotland executed by William Roy over the years 1747-55 (BM, K.Top.XLVII, 25-16, in 38 sheets). It is at a scale of about 1:36,000, and the distribution of tillage is indicated by parallel lines to represent the cultivation ridges. Enclosures and settlement are illustrated in detail, as well as the location of shelter-belts, woodland, moorland and moss. If sufficient reliance can be placed on its completeness, the survey could provide a valuable record of the limit of cultivation in the mid-eighteenth century.

The technique of the survey and the history of the maps themselves are fully discussed by Inglis (1936: 61-62) and by Skelton (1967), whose conclusions are largely based on a memoir by Arrowsmith (1809). For present purposes only the date of the Military Survey in south-east Scotland and its accuracy with respect to the distribution of cultivation and settlement will be considered.

Date of the Survey

Following a successful pilot project at Fort Augustus in 1747-48, a full scale survey of the north of Scotland was put in hand in 1749 and completed by the autumn of 1751. A fair copy of the original protraction was prepared. It is evident that East Lothian was included in this early survey since there are extant for the region both a fair copy (BM, K.Top. XLVIII, 25-1b, c, sheets 8-5 and part of 8-4) and an original plan (BM, K.Top. XLVIII, 25-1a, roll 65).

The survey was extended in 1752 to take in southern Scotland, which was covered by two parties working northward from the Border (Skelton, 1967). It is evident, then, that the Stow Uplands and the southern Lammermuirs were surveyed during the summers following 1752, while the northern part of the study area had been fully mapped by 1751.

The original plan of the south, of which no fair copy was made, and the final protraction of the north were put together by an unknown officer of the British Museum between 1829 and 1844 (Skelton, 1967). Skelton justifies this 'reunion' of the two sets of rolls on the grounds that they fit together exactly and that no fair copy was made for the south, the assumption being that the two were designed as a single map for the whole country.

Some objections, however, may be raised against this assumption. The original plan of the south is less 'neat' than the fair copy of the north, and a comparison of the coverage of the Border area and the fair plan of East Lothian reveals great contrasts not only in quality of map-work but in locational accuracy and comprehensiveness. An inspection of the southern roll indicates that the close fit with the northern survey is achieved through a gradual increase in the neatness of the original protraction from south to north. The suggestion is, therefore, that a decision was taken in about 1754-56 to adapt what had initially been intended as a rough draft so that it would stand as the final map.

A reason for this decision may have been the critical military situation in North America and the threat of a French invasion of southern England in 1755. Several engineers, including the director of the Military Survey, Lieutenant-Colonel David Watson, were recalled to survey fortifications on the south coast. The pressure on Roy to complete the survey was clearly increasing (Roy, 1785).

Support is lent to this argument by the existence among the original rolls in the British Museum of what are clearly fair copies of Lauderdale and Kelso (classified incorrectly as rolls of the original protraction of the north: BM, K.Top. XLVIII, 25-1a, rolls 54 and 38) on which corrections and improvements were inserted. Similar fair copies for East Lothian include a quantity of extra information that is clearly the result of a systematic correction of the first drafts in the spring following the winter collation. The suggestion is, then, that the rolls of Lauderdale and Kelso represent the results of checking for a final map that was never completed for southern Scotland, but was abandoned in 1755.

It seems reasonable to conclude that not only have the Military Survey sheets of the north and south of the study area been produced at different periods but they may also vary greatly in their completeness and accuracy. The junction of the north and south surveys is illustrated in Figure 5.1.

Accuracy of the Survey

Roy himself considered that, as a result of inadequate finances and the use of 'instruments of the common, or even inferior kind', the survey should be regarded 'as a magnificient military sketch rather than a very accurate map of a country' (Roy, 1785). Certainly the use of open-sighted theodolites and chain transects could have resulted in large cumulative errors when open traverses were made up long valleys (Thomson, 1832: iii). It seems that all the major roads and rivers were traversed and that most of the traverses were closed, but it is likely that the accuracy of the map detail rapidly diminishes with increasing distance from the lines of measurement since most data were located by visual estimation rather than by chained offsets. The error in these estimates may have been considerable in the plotting of settlement and cultivation sited some distance from the main lines of traverse.

However, an inspection of the original plan for East Lothian in the British Museum (BM, K.Top. XLVIII, 25-1a, roll 65) indicates that many improvements were later made to the initial survey both through the re-measurement of areas suspected of inaccuracy and through the inclusion of more field data. Thus the contrast between the original and fair copy for East Lothian cannot be accounted for solely in terms of alteration for neatness of the manuscript. It is clear that some areas were entirely re-surveyed. The difference in accuracy and completeness between the two manuscripts is therefore considerable, the suggestion being that some faith can be placed in the fair protraction of the north-west sector of the study area while some reservations must be made with respect to the unchecked original which covers the remainder of the region.

Yet the comprehensiveness of the Military Survey, particularly in recording individual features such as dispersed settlements, is greater than might be expected. In all, 717 discrete settlements are located in the study area, while 846 are recorded on more detailed maps of 1770-73 (infra p.120). Of the difference (129), it is evident from other county maps and from estate documents that only 35 were in existence in 1750 and 1770 but were overlooked by Roy. It is probable that at least 70, and possibly the remaining 24, were established in the twenty-year interim period. Some reliance can thus be placed on the Military Survey as a record of mid-eighteenth century rural settlement.

Less reliance may be placed on the distribution of cultivation, although O'Dell (1953) and Skelton (1967) have assumed that the limits of tillage and waste have been accurately defined, since this would be a particular requisite of a military map. Such an assumption is probably based on the precision with which the edge of the cultivated area has been penned by the draughtsman of the fair copy. The same is not true, however, for the original protraction. On this a broad representation is made only of the general distribution of tillage rather than its actual limits. While it has been noted that widespread checking was made of the initial survey, it is clear that a false appearance of precision is produced by the increased neatness of the fair copy. Yet it will become apparent from the following discussion that, while the detail is inaccurate, the synoptic limits of cultivation exhibited by the Military Survey are generally reliable.

Limits of cultivation on the Military Survey

The limits of cultivation in the study area as exhibited by the Military Survey are illustrated in Figure 5.1. Distinction is made between the earlier and more accurate coverage of the north-west, which is accepted as an accurate record, and that of the majority of the region, for which the cultivation limit may be interpreted only approximately.

It is evident that much the greater length of the limit lies below the edge of the 1860-1970 moorland core. There are, however, 28 locations, comprising a total of 500 ha, at which cultivation symbols on the Military Survey almost certainly correspond to the areas of abandoned cultivation mapped from aerial photographs. At a further nine locations comprising 105 ha the correspondence is less certain. Only two areas of tillage marked by the Survey lie within the moorland core yet cannot be related to sites on the map of abandoned land. One adjoins an isolated shieling site, later an inn, beside a hill track, and it is possible that the field evidence for cultivation at this site has been erased (Little Shiel, GR 588590). The other area represents an error on the part of the military surveyors, for the slopes on which the cultivation shading is located are far too steep for tillage (GR 630603).

The correspondence between the Military Survey and the field evidence is thus a valuable cross-check to both sources. It suggests that, albeit in a limited number of areas, the Survey accurately locates the distribution of early cultivation, and that at least ten per cent of the total abandoned land in the moorland core was under cultivation in the mid-eighteenth century. It is also clear that, at the same period, much of the Stow Uplands, of the Westruther platform and of Quixwood moor remained unimproved.

A discussion of the location of these limits of cultivation is presented later (infra p.182). It must suffice at the present to note that the Military Survey represents valuable evidence for the mapping of the former limit of cultivation. Its use in the dating of the advance and retreat of the limit is considered in Part III.

EVIDENCE OF THE FORMER DISTRIBUTION OF SETTLEMENT: THE SEQUENCE OF COUNTY MAPS

It has been noted that only one of the series of maps extant for south-east Scotland can be used to locate former limits of cultivation. All the remaining maps, however, indicate with varying degrees of accuracy the distribution of settlement and woodland. Reference has been made to the value of a knowledge of the early settlement fringe as an indirect method of mapping former limits of cultivation. In this respect it is important both as an addition to and as a check on the aerial survey of abandoned land. Furthermore, it provides an indication of the length of time over which the abandoned land was in use, and it lays the foundation for the later dating of its reclamation and reversion.

Checking the map sequence

It is important that adequate evaluation is made of each map to ascertain its completeness and the accuracy of its location of data (Coppock, 1969); and, since the maps will be later compared among themselves to assess changes in the quantity and distribution of settlement, it is necessary to select a sequence which is representative of landscape changes throughout the period of study. An attempt is therefore made to date the surveys and to establish the degrees to which they are original records illustrative of the early landscape or are the product of the plagiarism of previous surveys, containing data which perhaps did not exist at the period they purport to represent.

Evaluation of the maps is made by reference to other large-scale county surveys of the sequence, to contemporary estate plans, and to modern map and field evidence.

Pont, Gordon and Blaeu: c.1583-1654

Since the work of Cash (1901, 1907) some attention has been given to the surveys for Blaeu's Atlas Novus of 1654 (Inglis, 1936; Moir and Skelton, 1968; Kinniburgh, 1968; Megaw, 1969; Stone, 1968, 1970, 1971). Much of this has attempted to distinguish between the contribution of the surveys of Pont and those of Robert and James Gordon to the published maps. The studies are important, for up to forty or fifty years may separate the periods which the final maps represent.

The coverage for East Lothian in Blaeu's Atlas (Lothian and Linlitquo) is a close copy of a published map by Pont (A New Description of the Shyres of Lothian and Linlitquo). The latter is undated but was engraved by Judocus Hondius who died in 1611. Inglis (1936: 104) thus assumes that it was first published in 1610. It is likely, however, that the surveys for the map were carried out over the period 1583-1601, between Pont's graduation from St Andrews university and his appointment to the ministry of Dunnet Parish, Caithness (Cash, 1901). Stone (1971) has noted that those maps which are entirely the result of Pont's work must portray a pre-1596 landscape. The Pont/Hondius (1631), Pont/Jansson (1646) and Blaeu maps of the Lothians thus date from the end of the sixteenth century. There is no suggestion that they were updated for the later publications (Moir and Skelton, 1968).

The coverage for the southern part of the study area is less simply attributed. The maps in the Atlas Novus, The Merce or Shirrefdome of Berwick and Lauderdalia, are both assigned to Timothy Pont. But there is extant a manuscript by Gordon (A Description of the Province of the Merche, G.58, NLS) which, although not identical, was almost certainly used by Blaeu to compile the published map. The Pont manuscript, if it existed, does not survive. It is not possible, then, to attribute with certainty the original survey to either Pont or Gordon. But the picture that emerges from studies of the Pont and Gordon manuscripts for other parts of Scotland suggests that Gordon copied, checked and incorporated new material into the Pont draft (Stone, 1970, 1971). The period over which Robert and James Gordon are known to have been working on the drafts for Blaeu is 1636-48. The coverage in the Atlas Novus for Berwickshire must therefore be ascribed to this date, although it is by no means certain how much of Pont's earlier fieldwork is embodied in the final print. It is clear, therefore, that the early map record for the northern and southern parts of the study area may well refer to entirely separate periods.

Neither the Gordon manuscript Etricke Forest (G.57, NLS) nor the Blaeu Twee-dail with Selkirk provide a coverage of any part of the study area.

The completeness of these early surveys is difficult to assess without sufficient contemporary yardsticks, for there are no estate plans extant for this period in south-east Scotland. It will never be known exactly how many steadings which did exist at the time of the surveys were omitted but it is clear that an abstractness, which is due to the lack of back-ground topographic mapping by Pont and Gordon, gives an impression of a generally low level of comprehensiveness. This is misleading, for an analysis of the maps reveals the close attention given to detail. A total of 405 towns, fermetouns and steadings is located by Pont and Gordon in the study area, while 717 are exhibited by the later Military Survey of much larger scale. If, as analysis of other material in Chapter 8 suggests, there was about a ten per cent increase in the total number of discrete settlements in the study area in the intervening century, it seems that the Blaeu maps present about a 70 per cent coverage of existing settlement. This conclusion is a qualification of Lebon's assertion that the Pont manuscripts are a faithfull record of the seventeenth century landscape (Lebon, 1952).

There is no suggestion that those settlements omitted were small and isolated. Indeed, the maps are the most comprehensive in their coverage of the remote areas in the central Lammermuirs.

It would be unsatisfactory, however, to infer the establishment of new steadings between 1650 and 1750 in those areas where settlements are located by the Military Survey but not by Blaeu. But it may be valid to assume the abandonment of steadings which are marked by Blaeu, and the existence of which can be corroborated by other sources, but which are not marked on later maps.

The locational accuracy of the surveys by Pont and Gordon varies remarkably from region to region. There are instances of settlements being recorded more than 8 km from others that were, in fact, adjacent to them. Indeed, it is clear that Pont's surveying showed greater accuracy in direction than in distance (Stone, 1968). There are, however, only six steadings within the study area for which sites cannot be precisely located by the study of place-names on aerial photographs.

It may be concluded that only three Pont, Gordon or Blaeu maps warrant a study of their settlement distribution. These are the Pont/ Hondius map (1610), the Blaeu <u>Merce</u> (1654) and the Blaeu <u>Lauderdalia</u> (1654). The date of the first has been put at 1583-96, and of the others at 1636-48. Confidence can be placed in the data these maps provide on settlement if these are corroborated by other evidence. The absence of detailed earlier maps eliminates the possibility of plagiarism.

John Adair: 1682

The Map of Midlothian (1735) is a reduced copy of a manuscript surveyed in about 1680 (A.9, NLS). Neither this nor the manuscript of a similar date for The Sherifdome of Etrike Forest (A.12, NLS) provides a coverage of the study area.

The Map of East Lothian (1736) provides the only late-seventeenth century coverage of south-east Scotland, but it is an almost exact copy of a manuscript of 1682 (A.10, NLS). Some minor changes were made by the engraver, apparently for the benefit of neater production, for these included the omission of some settlements that continued to exist into the eighteenth century. Certainly none of the changes represents an up-dating of the original work.

Inglis (1918) has noted the precision with which Adair worked. The published maps of the survey by Pont would certainly have been available for reference but there is no indication that Adair borrowed from them. He located a third more settlements than did the earlier cartographers for the same area. Three steadings are also omitted on his map which are indicated by Pont and are confirmed by place-name evidence, and since there is no mention of these by later surveyors or in estate documents, the suggestion is that they were abandoned between 1596 and 1682. It thus seems that Adair either did not refer to Pont's survey, or was at pains to check for changes that might have occurred in the preceding ninety years. It would be valid, then, to make comparisons between the Adair manuscript and the Pont maps with respect to changes in the settlement fringe.

Elphinstone and Millar, 1744-45

These are almost exact, but reduced, copies of the Cooper engraving of Adair (1736).

Laurie, Stobie and Armstrong: 1763-73

Laurie's Map of the County of Midlothian (1763) is the first county plan in Scotland to be surveyed on modern lines. The author's attention to detail is borne out by the large number of steadings located on his map, all of which can be confirmed by their continued existence or by evidence of their original site. The Military Survey, which antedates the work of Laurie by about ten years, does not seem to have been made available to any of the county surveyors except Arrowsmith who was allowed access to it in 1805-6 (Inglis, 1936: 90; Skelton, 1967). Furthermore, considerably greater detail is plotted by Laurie for 1763 than had appeared on any of the previous surveys. The accuracy and originality of Laurie's work is therefore not in question.

Matthew Stobie's Roxburghshire, surveyed in 1770, is apparently in part a compilation of his own estate surveys. A substantial increase in accuracy over the Military Survey is illustrated by the plotting of 17 per cent more settlements. About five per cent of the steadings marked by Roy in the Roxburghshire part of the study area are not indicated by Stobie, and, since he evidently did not plagiarise earlier surveys, it would be valid to make comparisons between Stobie's work and the rolls of the Military Survey in order to evaluate the number of settlements abandoned in the intervening twenty years.

The surveys of Captain Armstrong and his son, that for Berwickshire of 1771, and East Lothian of 1773, deserve similar respect. They are evidently the product of recent estate surveys with additional mapping of other areas. They should thus be dated over the period 1768-70 rather than tied to the year of publication.

The Map of the Lothians (1773) locates more than twice the number of steadings in the study area than did Adair for 1682, and 20 per cent more than did the Military Survey for 1750-52. The omission of five per cent of Roy's steadings suggests that the Military Survey was never referred to by the Armstrongs. More individual settlements are to be found for the study area on both the 1771 and 1773 maps than on the 1:25,000 Ordnance Survey coverage of 1954. This confirms the completeness and originality of the work. The only suggestion of any reference made to earlier surveys is the similarity of some unusual place-names to those marked by Blaeu. It is possible that the Armstrongs used the Pont and Gordon surveys as a basis for their own maps.

The map of Berwickshire (1772) is a reduction of that of 1771, and that by Ainslie (1777) is of too small a scale to record a comprehensive distribution of settlement.

Blackadder, Forrest and Knox: 1797-1812

The county maps on which John Blackadder and William Forrest were working in 1797 and 1799 were largely the product of their own estate plans. Both are known to have been surveying in their respective counties in the 1790s and both had established a reputation for their skills (Thomson, 1832: v-vi). There is no doubt that they referred to the work of the Armstrongs; there are particular similarities in the spelling of place-names that must be more than coincidental. But it is evident that much information was both added and omitted by the later cartographers. Ten per cent more settlements were recorded by Blackadder and Forrest than by the Armstrongs. Moreover, 71 fermetouns and steadings were located by the Armstrongs in 1771-73 and have been confirmed by aerial or philological survey, but were not noted on the later surveys. It is clear, then, that there was no wholesale transference of earlier data on to the county maps of the 1790s, and that most of the discrepancies between the maps of 1771-73 and those of 1797-99 are due to real changes in settlement rather than to an improved quality of the map-work itself. Thus the conclusion is that, while no firm inferences may be made concerning the establishment of settlements between 1771-73 and 1797-99, the omission from later and more detailed maps of settlements marked on earlier surveys may be indicative of their abandonment over the intervening period.

The map of Midlothian published by James Knox in 1816 is stated to have been based on a survey of 1812. Thomson (1832: v), however, notes that the author was engaged on its survey between 1804 and 1810. The accuracy and originality of Knox's work can be confirmed by arguments similar to those used in assessing that of Blackadder and Forrest.

Thomson: 1821-22

The maps in Thomson's Atlas of Scotland (1832) are, without exception, based on the work of earlier cartographers. In most cases this debt is acknowledged: Neele's engravings of Haddington (1822) and

Berwickshire (1821) are copies of Forrest (1799) and Blackadder (1797). Edinburghshire (1821-22) is based on the survey by Knox, and Hewitt's Roxburghshire (1822) is almost a facsimile of Stobie (1770). There is no evidence to suggest that the surveys were up-dated for their re-issue.

Sharp, Greenwood and Fowler, 1824-28

It is probable that the topographic basis of these maps is the work of an Ordnance Survey triangulation team which moved into Scotland in 1820 under the direction of Major-General Thomas Colby and surveyed in the region until 1825, after which it was called to Ireland at the time of the 'land question'. Detailed mapping by the Ordnance Survey did not begin in Scotland until the resumption of the trigonometrical survey in 1838 (Close, 1926: 89). It seems, therefore, that much of the data on settlement was collected in the field by Greenwood and Fowler for Berwickshire in 1825, for East Lothian in 1824 and for Midlothian in 1827-28. There is little correlation between these data and those on the maps of the 1790s; about 7 per cent of Blackadder's and Forrest's steadings are omitted by Sharp, and a further 8.5 per cent which were previously unrecorded are located.

The maps by Sharp, Greenwood and Fowler thus seem to provide a trustworthy coverage of the study area to bridge the period between the county maps of the late eighteenth century and the publication of the first edition of the Ordnance Survey in the 1850s.

Tennant: 1838

Tennant seems to have referred to the work of Stobie (or, at least, to Hewitt's copy) but made a large number of alterations to the map detail which are confirmed as accurate by contemporary estate documents.

Johnston: 1842; Fowler: 1845

The maps of Midlothian by W. and A.K. Johnston and by Fowler are facsimiles or compilations of the surveys by Greenwood and Fowler (1827-28).

Conclusion

It is evident from this discussion of the completeness, locational accuracy and originality of the cartographic record of south-east Scotland, that only fifteen maps, or half the total coverage, may be used as a basis for a study of changes in the distribution of upland settlement. These maps are listed in Table 5.2.

It will be noted that the maps provide a record of the settlement pattern over five distinct periods before the advent of the first Ordnance Survey coverage, viz.: c.1596-c.1648 (Pont, Gordon); 1749-55 (Military Survey); 1768-73 (Armstrongs, Stobie); 1797-1810 (Blackadder, Forrest, Knox); 1824-38 (Sharp *et al* and Tennant). Roxburghshire is not represented for the 1790s, and East Lothian has an extra record for 1682 that is not available for the remainder of the study area.

THE PATTERNS OF SETTLEMENT

It is evident that the sequence of county maps exhibits a widespread increase in the quantity of settlement as the cartographic record becomes more complete. The numbers of separate settlements for the period is summarised below:

Table 5.2

Selected large-scale county maps of south-east Scotland

approx date of survey	pub'n date	author	engraver	title	scale
EAST LOTHIAN					
1583-96	1610	Pont, T.	Hondius, J.	A New Description of the Shyres of Lothian and Linlitquo	1:101,376
1682		Adair, J.	MS	East Lothian (A.10, NLS)	1:76,032
1749-51/ 1752-55		Roy, W.	MS	The Military Survey of Scotland (BM, K.Top. XLVIII, 25-1a, roll 65; BM, K.Top. XLVIII, 25-1b, c, sheets 8-4, 5 and 9-3, 4)	1:36,000
1770-73	1773	Armstrong, Capt. A. and M.J.	Kitchin, T.	Map of the Three Lothians	1:63,360
1799	1801	Forrest, W.	Kirkwood, J.	Haddingtonshire	1:31,680
1824	1825	Sharp, Greenwood and Fowler	Dower, J.	County of Haddington	1:63,360
BERWICKSHIRE					
1636-48		Gordon, R. & J.	MS	A Description of the Province of the Merche (G.58, NLS)	1:147,480
1752-55		Roy, W.	MS	The Military Survey of Scotland (BM, K.Top. XLVIII, 25-1b, c, sheets 8-3, 4 and 9-2, 3)	1:36,000

Table 5.2 (contd)

approx date of survey	pub'n date	author	engraver	title	scale
1768-70	1771	Armstrong, Capt. A. and M.J.	Bell, A.	County of Berwick	1:63,360
1797	1797	Blackadder, J.	Ainslie, J.	Berwickshire	1:63,360
1825	1826	Sharp, Greenwood and Fowler	Dower, J.	County of Berwick	1:63,360
MIDLOTHIAN (Stow Uplands only)					
1583-96	1610	Pont, T.	Hondius, J.	(supra)	
1749-51/ 1752-55		Roy, W.	MS	The Military Survey of Scotland (BM, K.Top. XLVIII, 25-1b, c, sheets 7-4, 8-4)	1:36,000
1770-73	1773	Armstrong, Capt. A. and M.J.	(supra)		
1804-10	1816	Knox, J.	Neele, S.J.	Shire of Edinburgh	1:42,240
1827-28	1828	Sharp, Greenwood and Fowler	Dower, J.	County of Edinburgh	1:63,360
ROXBURGHSHIRE (Melrose Parish only)					
1752-55		Roy, W.	MS	The Military Survey of Scotland (BM, K.Top. XLVIII, 25-1b, c, sheets 8-3, 4, 7-3, 4)	1:36,000
1770	1770	Stobie, M.	Bayly, J.	Roxburghshire	1:101, 376
1838	1838	Tennant, N.	Johnston, W.	County of Roxburgh	1:42,240

1596-1648	406
1749-1755	717
1768-1773	846
1797-1810	849
1824-1838	883

Clearly the increases owing to improved surveying would make it invalid to infer the establishment of settlements which appear on later maps but not on earlier ones. It is interesting to note, however, that the distribution of settlement on the maps of Pont and Gordon (Fig.10.7) shows a surprisingly even spread from the periphery of the moorland core to the extremities of the study area. Over 8 per cent lies above the 800-foot contour (244 m O.D.) and over 2 per cent lies within the moorland core and is adjacent to abandoned land mapped from aerial photographs.

The major increases in the number of settlements recorded on the Military Survey, and on the county maps of the 1770s, the 1790s and the 1820s occur in the lowest and most accessible areas to the north and south of the Lammermuirs and in Lauderdale. Changes to the pattern of settlement above 250 m O.D. are small. But because of the difficulties in accounting for that proportion of the change which is due to increases in the comprehensiveness of the mapping, it is more valuable to consider those steadings which are recorded on the early maps in the sequence but are not noted by later surveys.

Checking of the originality of the fourteen selected maps has eliminated the possibility of plagiarism, and increases in the accuracy of the sequence make it unlikely that steadings which continued to function would be overlooked by the later surveyors, particularly when several of them may have had access to earlier maps. The implication appears to be that those settlements which disappear from the map record were in fact abandoned and became derelict in the intervening period.

In many cases this abandonment is confirmed by the disappearance of the settlements from estate maps and from the Register of Sasines. For some the process of amalgamation or complete abandonment is recorded in estate rentals and ledgers (infra p.246). It is not possible to provide substantiating evidence for each settlement but there is overwhelming evidence that their disappearance from the county and Ordnance Survey maps is a reliable indicator of their abandonment between 1596 and 1860. Whether the date of abandonment may be guessed from the point in the map sequence at which the settlement disappears is less certain. Consideration is given to this in the following chapter (infra p.166).

Comparison of the maps shows that 262 settlements appear at least once in the sequence of surveys but are unrecorded on a later map and certainly have not existed since 1860. Of these, the sites of only six, all of which are indicated on the maps of Pont or Gordon, cannot be located accurately, and it is possible that these were incorrectly mapped by their surveyors. The remaining 256, however, may be located by reference either to their association with place-names on the first edition 1:10,560 Ordnance Survey maps, or to relict evidence of their sites in the field or on aerial photographs. The existence of 98 per cent of the settlements may thus be confirmed by philological or field evidence.

Of the confirmed settlements 251 were evidently farmsteads or small fermetouns rather than inns or mills. The distribution of such abandoned steadings is illustrated in Figure 5.2. Many are located outwith the moorland core, their abandonment being probably the product of widespread amalgamation of farms. There is, however, a distinct concentration of abandonment near the periphery of the moorland core: over 42 per cent of the steadings lie within 0.75 km and 21 per cent within 0.25 km of the edge of the moorland (Table 5.3). It is possible, therefore, that the abandonment of steadings is associated with the permanent reversion of farmland as well as with farm amalgamation.

Table 5.3

Location of abandoned steadings
in relation to the edge of the moorland core

	above moorland edge	distance below moorland edge (km)					total
		<0.25	0.25-0.75	0.75-1.5	1.5-3.0	>3.0	
No. steadings	24	30	52	68	53	24	251
% total	9.6	11.9	20.7	27.1	21.1	9.6	100.0

sources: county map sequence
O.S. 1:10,560, 1853-60

This hypothesis is supported by the spatial correlation of several steadings with the location of abandoned cultivation. Figure 5.3 illustrates the distribution of 33 such abandoned farmsteads which were almost certainly linked to cultivated land that reverted to moor before 1860. The association cannot be established beyond doubt without reference to the pattern of holdings (infra p.177) but the field evidence, such as the relative locations of the steading and the land, the tracks which join them, as well as the distance from alternative farmsteads, is plentiful. About 1,240 ha of abandoned land have thus been provisionally linked to the 33 steadings.

It is evident, then, that 13 per cent of the settlements known to have been farm steadings and known to have been abandoned at one time between 1596 and 1860 were probably associated with the permanent reversion of 25 per cent of the abandoned land of the moorland core.

The mapping of abandoned steadings from the county map sequence thus provides confirmation of the aerial and field survey on two levels. First, the spatial correlation of steadings and abandoned land suggests that a reasonable degree of accuracy has been achieved in the mapping of relict cultivation ridges. None of the 24 farmstead sites within the moorland core is located in an area for which no evidence of abandoned cultivation has been recorded; all may be related to specific plots of reverted farm land and there is no suggestion that other evidence for the distribution of abandoned land has been overlooked.

Secondly, the map record provides confirmation of the mapping from aerial photographs of several settlement sites. Of the 46 sites provisionally mapped from photographic and field evidence, 17 correspond to steadings which are initially recorded but later disappear from the county maps. These have been firmly related to their sites after reference to philological evidence and to estate plans. The remaining 29 are not confirmed.

Furthermore, there is now evidence to suggest that much of the abandoned land was associated with long-established settlement: one-quarter may be linked to farm steadings which are known to have been inhabited over a considerable time, most of them since the period 1596-1648. The implication is that the 4,890 ha of reverted farmland in the study area point to important former limits of long-term cultivation and are not the product of irregular outfield tillage.

MAPPING THE DATA : SUMMARY

An indication of former movements of the limit of cultivation since 1860 is available from a sequence of Ordnance Survey maps for the study area. However, the most comprehensive evidence for such movements prior to 1860 is to be found on the landscape and in a series of large-scale county maps.

Eleven per cent of the moorland core, which has been classified as rough pasture by the Ordnance Survey since 1860, was evidently cultivated at some time, possibly for long periods, before the mid-nineteenth century. It is evident that, prior to 1860, the limit of cultivation stood higher than it has at any time in the last century.

It is therefore possible to postulate two stages in the former movements of the limits of cultivation in south-east Scotland: pre-1860 and 1860-1970, the division between the stages being arbitrarily determined by the nature of available evidence. Within these divisions a four-fold classification of movement of the cultivation limit is apparent. A central area of 39,190 ha (29.8 per cent of the whole study area) has never been broken by a mould-board plough and is therefore unlikely to have been under cultivation since at least A.D. 500. A further 4,890 ha (3.6 per cent of the study area), largely at the periphery of the unbroken moorland, was reclaimed and cultivated for a substantial period but was abandoned before 1860, since when it has lain unimproved (Fig. 4.9). A third region of about 15,000 ha (c.11.4 per cent of the study area) has alternated between rough pasture and improved land between 1860 and 1970 (Fig. 8.9). Finally about 72,250 ha (c.55.2 per cent of the study area) has remained improved throughout the last century.

Similar stages in the abandonment of farm steadings may be recognised. Twenty-four per cent of the total settlements existing at any one time in the study area were abandoned between 1596 and 1860, and a further 10 per cent between 1860 and 1970.

The location and movements of the limit of cultivation since about A.D. 500 have thus been established. The dates of these movements - the phases of reclamation and reversion - are known for the period 1860-1970 but are not known for the period prior to 1860. However the consideration, first, of the morphology of cultivation ridges and, secondly, of changes in the distribution of early settlement, provides a basis for dating these trends. They will be considered in the following section, Part III.

PART III

THE DATING

PART III : INTRODUCTION

THE NEED FOR ADEQUATE DATING

The significance of the widespread existence of abandoned land to former limits of cultivation depends largely on two factors: the degree to which the land was cultivated over the same period and the length of time that it was in use. It is clear that any expansion of tillage which was temporary and which occurred at varying periods is of less significance to the present study than contemporaneous reclamation of moor and its continuous cultivation over the long term.

Clearly, the dating of the reclamation and reversion of former tillage will enable an assessment to be made of this contemporaneity and permanence. Moreover, it provides a framework for the explanation of locational changes of the limit of cultivation, which can most effectively be sought in the comparison of trends in land-use change with related developments in other sectors of the regional economy. These are discussed at length in Part IV.

THE SOURCES FOR DATING

The sources for dating reclamation and reversion of tillage may be discussed in four categories: those that are based, first, on absolute dating by isotopes or on relative dating from pollen, secondly, on evidence from place-names, thirdly, on a study of the relict landscape and, finally, on a study of published texts and manuscripts.

The most common form of isotope dating, from radiocarbons, is generally too coarse for recent and short chronologies. It has been used, however, in association with pollen analysis by Turner (1965) for the reconstruction of medieval land use in central Wales. Scharpenseel and others (1968) have even published radiocarbon figures of 110 ± 60 years. Yet, in spite of this, C^{14} dating is not generally considered effective over short time-scales and it is both expensive and laborious (Commonwealth Bureau of Soils, 1969).

More useful are pollen counts tied to an absolute chronology constructed from the available written record. This procedure has been developed effectively in the northern Pennines by Roberts, Turner and Ward (1972). There are several sites in the Lammermuir Hills which might reward an investigation along similar lines, particularly at locations where peat lies close to a plot of abandoned tillage but is distant from areas of more permanent cultivation (viz. Penshiel Hill, GR 638628). Here the pollen record may accurately reflect the history of tillage. It is clear, however, that, while palynological counting may establish the history of land use at specific upland sites, it is too lengthy a procedure for use in a broad survey.

The philological record for south-east Scotland is scant and the evidence from field-names for dating land reclamation is even less helpful. This is due largely to the absence of a comprehensive record of farms and fields in Scotland in the nineteenth century; for while tythe apportionments have been an important source for dating intake and settlement in the uplands of England (Eyre, 1954; Crossley, 1954; Chapman, 1961) and in Wales (Jones, 1953, 1955; Jones, 1959; Thomas, 1972), these are not available for Scotland. This loss is not compensated by evidence on estate surveys for, although more of these are extant for the study area than for most of upland Scotland, they make only scant reference to the names given to cultivated land before enclosure; and those which are recorded on estate plans more often describe the nature of the soil than the chronology of reclamation.

A more rewarding source for dating reclamation and abandonment in Scotland is evidence from the relict landscape, from trends in the appearance and disappearance of farm steadings from the sequence of large-scale county maps, and from the published and manuscript record. The following three chapters deal, in turn, with these methods of dating. They comprise a section which outlines a broad chronology of advance and retreat of cultivation over the last millenium, and which thus establishes the degree of contemporaneity and permanence of the former use of marginal land. The chronology provides a framework for the explanation of these changes.

CHAPTER 6

DATING FROM THE LANDSCAPE EVIDENCE

It has been noted that the morphologies of cultivation ridges and farm steadings in Scotland underwent substantial change during the late eighteenth century. Thus the forms which these features take on the relict landscape may point to the approximate date of abandonment of agriculture and settlement. The chronology that can be established by reference to these changes has the advantage of areal comprehensiveness that is not generally available from the written record. This chapter attempts to construct from evidence on the landscape a broad chronology for the entire study area which will be complemented by the analysis of settlement change on county maps (Chapter 7). This chronology will serve as a framework for extrapolation of dating from more detailed but areally limited sources in published texts, manuscripts and estate plans (Chapter 8).

Consideration is given to the technique of dating, first, from the morphology of the cultivation ridge and, secondly, from the form of settlement sites and the pattern of enclosure.

THE CULTIVATION RIDGE

The following section establishes the dates at which the cultivation ridge was introduced and superseded in south-east Scotland. A genetic classification of ridges is constructed, tested and dated.

Dating the introduction of the cultivation ridge

It has been asserted that cultivation ridges can be the product only of the mould-board plough. It is true that the assymetrical ard, which is known to have been in use in south-east Scotland in Romano-British times (Fenton, 1962-63), seems to have been used to turn a furrow slice consistently to the right and may have been used to construct narrow and low ridges at Iron Age hill forts and settlements such as Tamshiel Rig in Roxburghshire and Glenrath in Peeblesshire (RCHM(S), 1956, II: 427; RCHM(S), 1967, I: 29, 165-67; Stevenson, 1940-41). Yet without a mould-board the ard could not throw up the 'high-backed' ridges that are characteristic of much of the abandoned land in the study area.

While a heavy mould-board plough may have been used in southern Britain in the Romano-British period (Bowen, 1961: 11), it was probably not introduced into northern England or southern Scotland until some time later. The earliest evidence for its existence in the Scottish Borders comes from the finds of pebbles which were probably used as studs to reduce wear on the plough sole. In northern England the distribution of these pebbles is confined to areas of Scandinavian settlement but in southern Scotland it appears to coincide with the sites of monastic granges (Fenton, 1962-63). This may point to the introduction of the mould-board to Scotland by French monastic orders. 'At any rate, the fact remains that the presence of plough pebbles does suggest the use in Scotland of large ploughs with mould boards some time in the early medieval period' (Fenton, 1962-63: 278). These implements were evidently the forerunners of the 'old Scotch' plough which was specifically adapted to construct high ridges (Robertson, 1829: 126; Fenton, 1970b).

It may be concluded that the mould-board plough, and thus the cultivation ridge, was introduced to south-east Scotland in the post-Roman period, probably by A.D. 1150.

Dating the supersedence of the cultivation ridge

Since drainage was the raison d'etre of the cultivation ridge in upland Scotland (supra p.49) the date at which ridges became no longer common to tillage was determined by the introduction of an efficient alternative method of draining the soil. The timing of this change is important for it determines whether the cultivation ridge was still universal at the time of earliest surveying by the Ordnance Survey in the study area (1853-60), and it points to the latest possible date of abandonment of the pre-Ordnance Survey tillage that has been mapped from aerial photographs.

The amount of hollow draining that would have led to the removal of cultivation ridges before the 1850s seems to have been small. By the turn of the century it had been established on a broad scale on the better lands which could repay the investment, about 1p to 3p per metre (Somerville, 1805: 174). But it was certainly not widespread, and a number of writers commented in the early nineteenth century that large parts of the lowlands remained to be drained (Kerr, 1809: 357, 363; Farmer's Magazine, 1811: 517, 522; Robertson, 1829: 202). It is unlikely, then, that the marginal land in the study area would have been hollow-drained. Even if a small proportion had been, it is likely that the drains would have been laid along the lines of former furrows and that the ridges would have been maintained.

Tile draining seems to have been practised in Scotland in the late 1820s but was not systematised until the early 1830s (Skirving, 1873: 26; Smith, 1831; Low, 1834). It seems, however, to have been quickly adopted in East Lothian for in 1842 the Marquis of Tweeddale built the first machine for making U-shaped tiles (Hoelscher, 1963), large sums were being spent on drainage, the furrows were being removed and 'the land being laid down flat' (Greg, 1842: 14, 23). By the time of the Ordnance Survey's 'detail mapping' in the 1850s, eighteen tile works had been established in East Lothian and Berwickshire, of which three were in the study area.

However, the quantity of land in the foothills that was levelled and under-drained before 1860 was probably small. Sanderson (1863: 362) noted that drainage was not introduced 'on a gigantic scale' until grants were made available by the government in 1845. Most of the agricultural records of the period suggest that the boom in tile drainage and reclamation began about 1852-58 (Skirving, 1873: 26; Wilson, 1902; Gibb, 1921), resulting in the widespread removal of cultivation ridges after 1860 (Sanderson, 1863: 365). Closer consideration is given to tile drainage in Chapter 11.

The implication is that, at least on marginal arable near the limit of cultivation, the plough ridge was characteristic of tillage up to and beyond the date of the first mapping of detail by the Ordnance Survey. It is apparent, then, that the plots of former cultivation exhibiting cultivation ridges may have been abandoned at any time up to 1860.

It has thus been possible to establish the period during which former cultivation mapped from aerial photographs was reclaimed and abandoned: it seems unlikely that it was taken in before A.D. 1100 and it may have been abandoned at any time up to about 1860. Within this period two distinct phases may be recognised, 'pre-improvement' and 'post-improvement', the change from one phase to the other being reflected in changes in shape of the cultivation ridge. In the following section these changes are used for dating past movements of the cultivation limit.

Morphology of the cultivation ridge

During the mapping of the cultivation ridges from aerial photographs a distinction (Fig. 4.5) was made between:

Type 1 Curved ridges of irregular breadth (generally exceeding 7.0 m), amplitude often exceeding 0.2 m

Type 2 Straight ridges of regular breadth (generally less than 5.0 m), amplitude generally under 0.1 m

Type 3 Straight ridges of regular breadth (generally exceeding 5.0 m), amplitude generally less than 0.1 m

Type 4 Straight ridges of regular breadth overlying a vestigial pattern of curved, irregular ridges

This classification is arbitrary for it is based on the appearance of the ridges on aerial photographs rather than on their measurement in the field or on a proved functional or genetic difference between them. But it has been suggested that their contrasting forms are a product of levelling and straightening towards the end of the eighteenth century (supra p.65). If this is true, the classification may be a useful means of dating the abandonment of former tillage in the study area. The reliability of this procedure may be checked by:

1. assessing the validity of the classification by measurement in the field;

2. comparing the morphologies of the types of ridges with those forms known to be characteristic of pre-improvement or post-improvement ridges;

3. assessing more accurately the dates of changes in the shape of ridges.

If the classification proves to be valid as a genetic typology, the date of reversion may be assessed from the type of ridge that is characteristic of each plot of abandoned land in the study area.

The validity of the classification

The validity of the typology depends, first, on whether a significant difference in shape and size exists between the types of ridges and, secondly, on whether a sufficient degree of accuracy has been achieved in the distinction between the types on aerial photographs.

A contrast between Type 1 and Types 2 and 3 lies in the straightness of the ridges. This is apparent on the aerial photographs, on which it can be more readily checked than in the field. Straightness or curvature, however, may not be a diagnostic feature of all the types of ridges and it would clearly be unsatisfactory to base a conclusion on this distinction alone.

The documentary evidence for a functional differentiation of the ridge types is helpful. Contemporary texts on agriculture, particularly those which were advisory rather than descriptive of existing conditions, suggest that differences in breadth of ridge (Table 4.1) were more a response to different requirements of husbandry by particular crops and to variation in soil type, than to changes over time. This is especially emphasised by Hamilton (1713: 20), MacKintosh (1732: 16), Kames (1776: 69) and Forsyth (1804: 492-99), and their recommendations for the annual cleaving and gathering of ridges of varying heights and widths were closely followed by the more progressive farmers (Marchmont papers, SRO, GD 158, 1759: 7, 1760: 8; Robertson, 1829: 211). It is evident, therefore, that the distinction between ridge Types 2 and 3 is not genetically significant and is of little value to the dating of land abandonment.

It remains to test for a significant difference between the morphologies of Type 1 and Type 2/3 (combined) by a comparison in the field of their amplitude and width. Several factors tend to reduce the accuracy of such an approach, particularly the difficulty of measuring the amplitude of ridges, and the variation in the wasting of ridges and silting of furrows that has occurred since abandonment. Yet, despite its limitations, measurement in the field is the only sound method of ascertaining whether a real difference existed between these types of ridges.

<u>Selecting the sample</u> The 4,890 ha of abandoned land in the study area, contained in 297 discrete parcels, comprise 361 plots of distinct types of ridges. The area and number of plots for each type of ridge is summarised in Table 6.1.

Since the number of plots and, especially, ridges discouraged survey of the total population, a random sample of plots was selected for measurement. The variation in their number per type of ridge and the suggestion that there existed a greater 'between plot' variance in the

Table 6.1

Types of cultivation ridge in south-east Scotland, by number of plots and by area

type of ridge	no. of plots	area (ha)
1	222	3,005
2/3	106	1,432
4	11	263
not known	22	190
	361	4,890

width of Type 2/3 than of Type 1, determined the use of a variable sampling fraction: 10 per cent of Type 1 and 20 per cent of Type 2/3, which yielded samples of 22 and 21 respectively.

Within each sample plot one 1 ha^2 grid was selected and ten adjacent ridges, central to the grid, were surveyed. This modification of a multi-stage sample was designed to allow for most of the variation in size and number of plots. It was unlikely that a bias would occur from a tendency for one type of ridge to be associated with large plots, since the average size of plot per ridge type is similar.

Procedure On 430 ridges lying in 43 plots, measurements were made of those features which were thought to be diagnostic of the morphologies of the ridge types. These are illustrated diagrammatically in Figure 6.1. They include:

1. wave-length - the distance between adjacent ridge-crests.

2. ridge-furrow ratio - the ratio of the breadth of ridge to the breadth of furrow, the division between ridge and furrow being defined by the median line.

3. amplitude - the vertical distance between the crest of the ridge and the nadir of an adjacent furrow.

Accurate measurement of ridge-furrow ratio and amplitude required levelling, the digging of soil profiles and the use of plumb-lines in order to plot median lines and the true nadir of silted furrows. These made for a lengthy survey and could be carried out only for one pair of ridge and furrow in each one ha^2 grid. The measurements for ridge-furrow ratio and amplitude were, however, compared with estimates for nine adjacent ridges. This was considered a more reliable procedure than the approximate measurement of ten ridges per one ha^2 grid. Totals of measurements were thus 430 for wave-length, and 43 for both ridge-furrow ratio and amplitude.

Accuracy The measurements of wave-length and of ridge-furrow ratio are accurate to the nearest 10 cm, or ±1 per cent. These levels of accuracy are quite acceptable when compared with the changes in amplitude and breadth that will have resulted from the wasting of ridges and silting of furrows since the time of their abandonment. Yet it is clear that the quality of the data will not justify their treatment by parametric tests such as the Standard Error of the Difference. For this reason a comparison of the sample values is made by reference to dispersion diagrams. These will only suggest rather than confirm a level of significance in the difference between the types of ridges. They are, however, adequate for the purpose ofthe present discussion.

Errors in the measurement of amplitude may exceed ± 10 per cent and must be counted as unreliable.

Results Figure 6.2 illustrates the wave-lengths of 430 ridges measured in the sample survey. The mean wave-length of Type 1 is 8.0 m, 50 per cent lying between 6.8 m and 9.1 m, and of Type 2/3 is 5.2 m, 50 per cent lying within the range 4.1 m to 6.1 m. The relative positions of the quartiles suggest that there is a significant difference between the wave-lengths. Moreover, it is clear from the dispersion diagrams that 80 per cent of the wave-lengths of Type 2/3 are smaller than 80 per cent of those for Type 1.

Estimates of ridge-furrow ratios at 43 sampled sites are illustrated in Figure 6.3. The position of the quartiles implies a significant difference between the ridge types, although the size of sample makes this conclusion unreliable. Snedecor's F test shows, however, that the differences in ridge-furrow ratio are significant at the 0.1 per cent level.

It should be emphasised that the ridge-furrow ratio is a theoretical rather than a functional parameter of the cultivation ridge. The functional division between the ridge and the furrow - the junction between productive and unproductive land - seems to have varied with the moisture of the soil, the wetness of a particular season and the type of ridge. It is not, therefore, accurately defined by the median line. However, on the assumption that the ridge-furrow ratio roughly reflects the proportions of productive and unproductive land, it is evident that the proportion of furrow or waste was, on average, more than halved by the straightening and levelling of ridges in the eighteenth century (Fig. 6.3). This increased efficiency in the use of land was not explicitly mentioned by contemporary writers as being one of the many advantages gained by the levelling of ridges. Yet it is likely to have been one of the strongest incentives for improvement.

Some support for this hypothesis is given by the discovery near two sample sites, initially classified as Type 1, of a form of ridge that differs from both Types 1 and 2/3. It is clearly a modification of Type 1 which has been levelled but not straightened, and from which the furrow-stones had not been removed. The ridges were therefore permanent, and not cleared annually. The breadth of ridge was similar to that of Type 1 but, because they had been levelled, the ridge-furrow ratio was about 4:1-6:1. An inspection of the coverage of aerial photographs of all Type 1 plots revealed three other sites of 'modified Type 1' ridges. The implications of this discovery are discussed below (infra p.144).

Averages of the amplitude of ridges at 43 sampled sites are illustrated in Figure 6.3. The low levels of accuracy of the measurements, compounded by the varying degrees of wasting and silting, discourages a firm conclusion. The dispersion diagrams suggest, however, that the difference in amplitude between Type 1 and Type 2/3 is probably significant.

Conclusions It has been shown that differences between types of ridges in wave-length and ridge-furrow ratio are almost certainly significant, and in amplitude may be 'probably significant'. Thus the conclusions are, first, that morphological differences between ridge Types 1 and 2/3 are sufficiently great to warrant their distinction as separate types and, secondly, that this typology has been mapped accurately from aerial photographs.

In the following section the types of ridges are checked for correspondence with those characteristic of the periods before and after the agricultural improvement. This is achieved by comparing modern field measurements with the sizes of early ridges for which information is available in contemporary accounts (Table 4.1).

Comparison with the documentary evidence

The field survey has shown that quartiles of the wave-lengths of Type 1 lie at 6.8 m and 9.1 m, while reference to Table 4.1 will indicate that breadth of pre-improvement cultivation ridges averaged 18-24 feet (5.5-7.3 m). The documentary and field data are not strictly comparable since the former refer only to the breadth of an individual ridge, not to the distance from crest to crest. This accounts for its slightly lower value. However, the similarity of the full variation of ridge width (5.5-14.6 m) to that of the wave-length of Type 1 (4.5-13.5 m), and its contrast to that of Type 2/3, suggests that Type 1 represents the characteristic form of the pre-improvement ridge.

The suggestion is confirmed by the similarity between Type 2/3 and the post-improvement form. The quartile spread of wave-length is 4.1-6.1 m (Fig. 6.2), while the breadth most frequently quoted in contemporary accounts is 15 to 18 feet (4.6-5.5 m) (Table 4.1). The full variation is 2.6-9.4 m and 2.4-7.3 m respectively.

There are extant no contemporary data which are comparable to the ridge-furrow ratio. But the increase in the proportion of arable that resulted from the levelling and straightening of ridges is similar to the differences between the ridge-furrow ratios of Types 1 and 2/3 (Robertson, 1829: 22-23).

The lowering of the ridges and infilling of the furrows that has occurred since their abandonment has greatly reduced the amplitude of the cultivation ridges. Thus, while the documentary evidence points to heights of 90-120 cm for pre-improvement and about 45 cm for post-improvement forms of ridges (Table 4.1), the quartile spreads of sample measurements for Type 1 and Type 2/3 are only 19-27 cm and 6-14 cm respectively (Fig. 6.3).

<u>Summary</u>

It is therefore evident that two distinct types of cultivation ridge are characteristic of abandoned land in south-east Scotland: a curved, broad and high-backed form (Type 1) and a straight, levelled form (Type 2/3). During their mapping from aerial photographs, these types were distinguished and a sample survey has shown that this distinction has been accurately mapped and is based on morphological differences that are significant or, at the least, probably significant. A preliminary distinction between Types 2 and 3 was not found to be significant.

It is also evident that these two distinct types of ridge correspond to forms that prevailed before and after the period of ridge improvement. Type 1 corresponds to an unimproved form and is indicative of the abandonment of land before or during the movement to level and straighten ridges. Type 2/3 is an improved form and points to abandonment during or after the improving movement, certainly not before it.

Two sub-types of cultivation ridge are also evident on the landscape: a 'modified Type 1', levelled but not straightened, and Type 4. The occurrence of these forms of only partial improvement seem to point to lands that were marginal to cultivation and either could not bear the cost of straightening (Robertson, 1829: 202-204; Forsyth, 1804: 443; The Complete Farmer, 1807: 'Ridges') or were brought into cultivation for such short periods that they did not warrant it. They are almost certainly indicative of land that was abandoned during or shortly after the movement to improve cultivation ridges.

It is clear, then, that the distribution of ridges of Types 1 and 2/3 is a valuable pointer to the date of abandonment of cultivation. Its value depends, however, on a knowledge of the date at which the ridges were straightened and levelled. This is considered in the following section.

Dating the classification: the sources

The stimulus for change The most effective method of dating the levelling of ridges is to consider, briefly, the reasons for the change.

The major incentive for change lay in advantages which low and straight ridges held over those that were crooked and high. Most important was the improvement in drainage, which had been poor owing to the ponding up of water at bends in the traditional ridges, the excessive wetness of their furrows and the dryness of the high crowns (Kames, 1776: 71). The new ridges were designed to improve run-off or to retain moisture where this was required (Hamilton, 1713: 20; Kames, 1776: 69;

Naismyth, 1807: 296-97; The Complete Farmer, 1807: 'Ridges'; Robertson, 1829: 211). Improved drainage, and the reduced shading consequent on lowering of the ridges, enabled oats to be sown at least a fortnight earlier and bere sometimes a month earlier than had been traditionally possible (Robertson, 1829: 229). This not only brought forward the harvest but reduced losses by shaking in early and mid-summer.

The straightness of the new ridges made for easier ploughing (Kames, 1776: 71-72) and their uniform width greatly increased the efficiency of labour in sowing, weeding and harvesting (The Complete Farmer, 1807: 'Ridges'; Robertson, 1829: 210, 226). Moreover, their height and width permitted the annual alternation of crown and furrow, thus preventing the permanent burial of topsoil (Kames, 1776: 74).

But it is clear that a secondary incentive for change, which may well have determined its date, was the introduction of Small's swing-plough. Since this was much lighter and of less sturdy construction than the 'old Scotch' plough, it could less easily break up the unploughed balks and might be damaged by 'sit-fast' stones in furrows (Robertson, 1829: 197). Moreover, its advantages over the traditional model, particularly the reduction in number of draught animals, the obviation of the need for a driver and the ease with which it could turn a straight furrow, were lost in the tillage of crooked and uneven ridges. On these as much draught- and man-power would have been required by the new as by the old plough (Robertson, 1829: 132, 197). Finally, Small's plough was not specially designed, as its predecessor had been, to throw the furrow far up-ridge (Forsyth, 1804: 254). There were a number of reasons, therefore, for the date of introduction of the new plough to influence the date of change in cultivation ridges.

The introduction of new field crops, particularly of root crops and sown grasses, and the realisation that their physiological needs and those of their husbandry placed particular advantage in the gathering of ridges of varying width from year to year, were also important stimuli to the introduction of levelling (The Complete Farmer, 1807: 'Ridges').

Levelling was also encouraged by enclosure, which increased the value of land and thus its ability to repay the cost of this improvement, which could exceed £3 an acre or about four times the annual rent of marginal arable land in the 1770s (Anderson, 1777: III: 199-231).

It is evident, therefore, that sources for dating the improvement of cultivation ridges may be sought not only in contemporary accounts of the movement itself, but in the timing of the appearance in marginal areas of a number of indicators. These include enclosure and the improved plough.

<u>Dating the classification: the timing of the change</u>

<u>The contemporary literature</u> The earliest mention of improved ridges in Scotland was made in 1699 (Hamilton, 1713: 9). Methods of alteration are discussed in several advisory writings published in the mid-eighteenth century (MacKintosh, 1732: 14-16; Dickson, 1762: 291-99; Kames, 1776: 57-58, 69; Anderson, 1777: 199-231), but it is clear that, in spite of the growing quantity of literature advocating its removal, the traditional ridge was still a common feature in the 1770s:

> Custom is no where more prevalent than in the form of ridges. No less high than broad, they are enormous masses of accumulated earth, that admit not cross-ploughing, nor any ploughing but gathering and clearing. Custom and imitation are so powerful, as that our ridges are no less high in the steepest bank, than in the flattest field
> (Kames, 1776: 362-63)

The continued attention to levelling up to the turn of the century (Forsyth, 1804: 437-46, 492-99) is likely to reflect at least a gradual change, but the suggestion is that this change occurred on a broad scale only 'in those parts of the country where a spirit of improvement has taken place' (Naismyth, 1807: 297).

This is confirmed by a study of the literature descriptive of agriculture in south-east Scotland. The earliest levelling and straightening in East Lothian was noted by a reporter for the Board of Agriculture to have been carried out at Whitekirk in 1723 (Hepburn, 1794: 52). Widespread levelling and straightening occurred on the lands of the more progressive farmers in the upper Merse between about 1757 and 1778 (Wight, 1778: II: 228, 233, 240, 310, 319, 323, 339, 352). Yet only two of the examples cited by Wight were probably located within 5 km of the contemporary limit of cultivation. It is, in fact, possible that even in the early nineteenth century areas peripheral to the intensive cultivation of cereals in East Lothian were characterised by the traditional crooked and high-backed ridge (Somerville, 1805: 98; Robertson, 1829: 211).

Apart from the most marginal lands, the infields were the last to be levelled, owing to the dangers of loss of soil fertility (Wight, 1778: II: 323; Kerr, 1809: 193) which, with the expense of the improvements and the dead weight of tradition, did much to retard the progress of levelling among the less progressive farmers on marginal land in the foothills (Robertson, 1829: 200-202; Kames, 1776: 362). Thus, while the major improvements in the Lower Merse and on the Haddington plain were carried out in the 1760s and 1770s, it is reasonable to assume that few improvements to cultivation ridges took place on higher lands until after 1780.

The manuscript evidence It would be unsatisfactory to draw any firm conclusions from the evidence of the eighteenth century 'improvers' and the reporters of the Board of Agriculture alone, for their information was often secondhand and contradictory. The implications of their analysis are, however, confirmed by a study of manuscript estate plans of the study area.

From these it is clear that the traditional form of ridge remained in use in remote areas well into the 1790s. It occurs below the northern scarp of the Lammermuirs on land that was abandoned after 1792 (GR 673712; RHP 1037: Waldalie, 1792; a/p: F62: 58/RAF/3262: 0296-7)* and is even characteristic of sites in upper Lauderdale and above the Whiteadder Water which probably reverted after 1818 and 1830 (GR 525585; RHP 1258: Tullis Hill, 1818; a/p: 106G/SCOT/UK 15: 5052-4, GR 647648; RHP 10013: Gammelshiells, 1830; a/p: 106G/SCOT/UK 11: 7160-1). At these sites an inertia which promoted the continuity of the high-backed ridge was reinforced by, first, the extreme marginality of the land to cultivation and, secondly, the only brief periods of

* For guide to references, see p.xvii

cropping which consequently occurred on it in the post-Napoleonic era. Typical of these two locations is the incidence of ridge Type 4 which is indicative either of abandonment or of only intermittent cultivation after improvement. More sustained tillage would have obliterated traces of the original ridges.

It seems that, up to the 1770s, the traditional form of ridge was often established on newly reclaimed land. This is suggested by the piecemeal reclamation which followed the division of Coldingham Common in 1776 (GR 845665; RHP 62, 155, 6144: Coldingham Common, 1765, 1772-73; a/p: 106G/SCOT/UK 11: 7187-8). The aerial photographs of areas which were abandoned soon after their initial intake reveal a mixture of Type 1 and Type 2/3.

But by the 1780s the straight ridge became characteristic of reclaimed land (GR 710716; RHP 5528: Innerwick Common, 1783; a/p: 106G/SCOT/UK 11: 5231-3), and on all but the most remote lands that had been under cultivation before the introduction of the improvements, the high-backed ridges seem to have been levelled by the 1800s. This is indicated by a study of the estate plans, county maps and aerial photographs of the area around Aikengall (GR 707697; RHP 2514, 2519: Blackcastle, 1753, Aikengall, 1823; a/p: 106G/SCOT/UK 11: 7031-3), Marchmont (GR 682520; Marchmont House: Marchmont, 1765, 1825; a/p: 106G/SCOT/UK 20: 7121-2) and Dod Hill (GR 526567; RHP 1215/1: Riddel Lodge, 1808; a/p: 58/RAF/3262: F61: 0212-4). However the evidence suggests that Type 4 and 'modified Type 1' ridges are often indicative of abandonment after about 1800 (GR 755645; RHP 3550;

Chirnside Common, 1805; a/p: 58/RAF/3262: F65: 0188-9), and, at some locations, even after 1825 (GR 751599; a/p: 106G/SCOT/UK 15: 5307-8).

The conclusion is that, while the traditional form of ridge had disappeared from the lowlands by 1780 and from the foothill zone by 1790, it remained common in the most remote parts of the study area until 1800. In exceptional circumstances the intermittent cultivation of unmodified ridges continued up to about 1830, although this is more commonly reflected in a relict pattern of the superimposed (Type 4) or the 'modified Type 1' forms. After 1780 the straight ridge was established on new intakes, but may not have appeared on sites of more long-standing tillage until the turn of the century.

It is clear, then, that the form of ridge that survives on the present landscape may be used to indicate, perhaps to the nearest two decades, the date of reclamation or abandonment of former tillage in south-east Scotland. The accuracy of this indicator may be increased, however, by dating the introduction of the swing-plough.

<u>The appearance of the swing-plough</u> It has been suggested that the incentive to level and straighten ridges was considerably increased by the appearance of a plough that could more easily turn a straight furrow and which could operate only with difficulty on high-backed ridges. Dating the appearance of this plough may thus enable the timing of the reclamation and abandonment of former tillage to be assessed with greater precision.

The swing-plough was first produced in 1763 by James Small at

Blackadder Mount in the parish of Edrom, on the south-east margin of the study area. It became available to local farmers the following year (Wight, 1778: II: 303, 317) and within a decade was in widespread use in the Upper and Lower Merse (Kames, 1776: 7; Wight, 1778: II: 237, 276). In East Lothian it was introduced in 1772 but was not in general use until about 1780 (Somervile, 1805: 88; Farmer's Magazine, 1811: 515). By 1795 it was reported in the Statistical Account as having entirely replaced the 'old Scotch' plough in seven parishes in the study area: Humbie, Whittingehame, Yester, Garvald and Bara, Bunkle and Preston, Langton and Melrose (OSA, 1792: VI: 157; II: 358; I: 345; 1793: VII: 356; 1792: III: 157; 1795: XIV: 599; 1793: IX: 79). In the remote and marginal areas, however, its adoption was delayed, for in three parishes (Lauder, Innerwick and Greenlaw) all with large proportions of hill land, the traditional model was still in use in the 1790s (OSA, 1792: I: 75, 121-22; 1795: XIV: 506-507).

The implication is that the 'old Scotch' plough was used in the cultivation of upland arable in the study area until almost the turn of the century. This confirms the dating suggested by the published and manuscript sources, implying the possibility of continued cultivation on high-backed and crooked ridges at least up to the 1790s and possibly later.

<u>The progress of enclosure</u> The spread of the enclosure movement in south-east Scotland is reserved for later discussion. It is worthwhile, however, to consider the general trends that may be drawn from the bulk of the evidence. From a study of the published, manuscript and

field sources it is clear (infra p.343) that, while there was widespread emparkment of small areas in the seventeenth century, large-scale enclosure of arable in the Lothians did not occur until the 1720s. After 1760 the movement slowly achieved momentum in Berwickshire and East Lothian so that by 1780 about one-half of the arable of the two counties was enclosed. The peak of the movement seems to have been reached in the decade 1780-90 but extensive areas of high-lying arable land, particularly on the southern slopes of the Lammermuirs, lay open in the 1790s. A number of these were enclosed during the Napoleonic wars but many remained open until the 1850s and some, which were put down to permanent grass after the turn of the century, were never enclosed. It is apparent, therefore, that on high arable land in the study area there was often little incentive to improve cultivation ridges.

Conclusions It may be concluded from this discussion that, on lower land at the periphery of the study area, the majority of cultivation ridges had been levelled and straightened by 1780. On the foothills of the Lammermuir Hills, however, the improvements were delayed for perhaps a decade and, on the highest land, were not effected until 1800. In a few remote areas unmodified ridges continued to be cultivated up to about 1830. Thus, with the exception of the latter, traditional cultivation ridges on sites of former tillage are indicative of abandonment before 1800. Conversely the occurrence of straight ridges on all sites except those peripheral to the study area suggests abandonment after 1800, probably after 1810. Peripheral sites exhibiting straight ridges may have been abandoned before 1780.

The incidence of 'modified Type 1' or of Type 4 is indicative of abandonment between 1800 and 1830 but possibly up to the 1850s. It is conclusive evidence of tillage before 1780 and it may reflect intermittent rather than perennial cultivation between 1800 and the date of abandonment.

FORM OF SETTLEMENT AND ENCLOSURE

The use of alternative methods for dating the abandonment of land may be valuable in three ways. First, it provides for the modification or confirmation of conclusions drawn from the analysis of cultivation ridges. Secondly, it enables the reversion at those sites illustrating modified or superimposed forms of ridges to be more precisely dated. Finally, it allows the dating of abandonment of those sites at which the pattern of ridges is too confused by gulleying or by the vegetation cover to allow accurate classification from aerial photographs.

Settlement forms

The classification of settlement forms which has been proposed suggests that there was a change in the morphology of steadings in south-east Scotland toward the end of the eighteenth century. The contrast in the morphologies is evident from the county inventories of the RCHM(S) (supra p.67) and is discussed at length by Robertson (1829: 71-91). Thus it is generally possible to distinguish on aerial photographs between the sites of pre-improvement and post-improvement steadings from changes to the shape and size of the kail-yard, and from the replacement of the 'biggin' (or but-and-ben) by a more formal plan of adjacent farm-house and offices.

These changes in the layout of steadings seem to have been far advanced in the lower districts of East Lothian by 1765, while the traditional form was still evident in the most remote areas fifty years later (Robertson, 1829: 80). They thus seem to be roughly contemporary with the modifications to the cultivation ridges, and it is logical that these improvements, and others, should have been made over the same period (infra pp.337-55).

Both the cultivation ridge and the settlement form are, then, indicators of the timing of land abandonment and land reclamation. A study of aerial photographs for those sites at which the appearance of cultivation ridges is confused has enabled the date of the abandonment to be placed either before 1790 (e.g. Birkcleugh, GR 678655) or after 1790 (e.g. Dirrington, GR 686555; Fangers, GR 500497), and the date of reclamation to be placed after 1760 (e.g. Riddel Lodge, GR 526567).

The value of this indicator is greatly reduced, however, by the difficulty of identifying settlement sites on aerial photographs (supra p. 76) and is consequently a less comprehensive method of dating reclamation and abandonment than is the cultivation ridge.

Patterns of enclosure

A third feature which may be used to date reclamation and abandonment is enclosure, the form and date of which have been already considered (supra pp.68,152). In a similar way to settlement, these may be used as sources which are complementary to the classification of cultivation ridges.

DATE OF RECLAMATION AND ABANDONMENT: THE SURVEY

A study from aerial photographs of the morphology of cultivation ridges, complemented by the interpretation of settlement form and enclosure, enabled an assessment to be made, for almost every plot of former tillage in the study area, as to whether abandonment preceded or followed the agricultural improvement. Moreover, for those sites which are known to have been taken in from the moor in the century preceding 1860, it was possible to suggest whether the reclamation pre- or post-dated the improvement. The timing of the improvement itself can be estimated to the nearest decade for different parts of the study area.

Although not a wholly accurate technique for dating, the value of this method lies in its comprehensiveness, for it has been possible to classify all but 27 plots (totalling 190 ha) according to a characteristic shape of ridge and, of these, 14 may be classified according to settlement or enclosure. Only 13 plots (87 ha) of former tillage do not exhibit a diagnostic landscape feature, due generally to an inadequate coverage of aerial photographs or to difficulties in field checking.

Results of the survey

The results of the survey are illustrated in Figure 6.4 and are summarised in Table 6.2. It is evident that 106 plots comprising 29 per cent (1,432 ha) of the former arable in the study area are characterised by levelled and straight ridges, the suggestion being that these plots were almost certainly cultivated after 1790 and were probably not abandoned until after the turn of the century. There is no indication on the

Table 6.2

Area and date of abandoned cultivation, by type of landscape indicator

date	indicator	no. of plots	area (ha)	% of total abandoned cultivation
pre-improvement				
	ridge Type 1	212	2,957	60.5
	settlement form + enclosure	5	33	0.6
post-improvement				
	ridge Type 2/3	106	1,432	29.3
	ridge Type 4	11	263	5.4
	ridge 'modified Type 1'	5	48	1.0
	settlement form + enclosure	9	70	1.4
not known		13	87	1.8
	TOTALS	361	4,890	100.0

relict landscape that they were cultivated before 1790 and it is possible that a large number were initially reclaimed over the period 1790-1850.

A further 6 per cent (311 ha) of former tillage exhibits ridges of either Type 4 or 'modified Type 1' which confirms the existence of cultivation before 1780 and its continuance, perhaps intermittently, until at least 1800. With the addition of evidence from settlement and enclosure, it may be concluded that about 37 per cent (1,813 ha) of the former arable was certainly abandoned during the period 1780-1860, probably after 1800.

The remaining 2,990 ha of abandoned land exhibit unimproved ridges and settlement forms which are indicative of initial reclamation before 1780. The suggestion is that this land reverted to moor probably before 1810, but perhaps not before 1820-30.

It has thus been possible to distinguish broadly between, first, those areas reclaimed before and after the decade 1780-90 and, secondly, those areas abandoned before and after the end of the eighteenth century. While this chronology is accurate only to the nearest decade, its areal comprehensiveness enables the date of reclamation and abandonment to be estimated for the entire moorland core in the study area.

Analysis of the survey: at the small scale

Examination of Figure 6.4 reveals a regional pattern in the distribution of pre- and post-improvement features. This pattern might be more marked were it not for the location of a number of commonties which were divided in the late eighteenth or early nineteenth centuries (infra p.363). Some of these are characterised by improved forms of cultivation ridge, since their reclamation followed quickly on the release of land for legal cultivation. Indeed, about 310 ha of divided commonty was reclaimed after 1780 but abandoned before 1850. This represents about one-sixth of the post-improvement abandonment in the study area and explains much of its distribution.

In addition to this there is the concentration of post-improvement abandonment in upper Lauderdale and near Fala Moor on the north-western edge of the study area; and in contrast there is a predominance of pre-improvement landscape features on the slopes above the upper Dye, Whiteadder and Monynut Waters, which suggests an earlier date for reclamation and abandonment in these areas.

Near Longformacus and Greenlaw the mixture of both pre- and post-improvement forms suggests that contraction of arable land had been widespread before and during the period 1780-1830, for those plots exhibiting the more recent forms of cultivation are located nearest to the infields and steadings.

A similar arrangement of pre-improvement and post-improvement tillage is common to a number of specific sites in the study area. Indeed, it is borne out by a summary of the pattern: of the total area of abandoned land which lies above the 750-foot (229 m) contour, 67 per cent is characterised by an unimproved form of ridge, while below this height 59 per cent is characterised by improved ridges. On average, therefore, improved ridges are located at lower levels than those that are high-backed and crooked.

This distribution may be the product of three factors. First, it has been noted that the widespread implementation of improvements on upland arable may have been delayed up to a decade after their appearance in the foothills of the Lammermuirs (supra p.150). Thus a contrast between the types of cultivation ridge on upland and foothill could remain even if there had been widespread and contemporaneous abandonment of tillage in both regions between about 1790 and 1810.

Secondly, in spite of the evidence which suggests that some farmers delayed levelling their infields for fear of loss in soil fertility, it seems likely that improvements were first effected on those lands near the steading. These would tend to be least marginal and might sooner repay the cost of levelling and straightening.

Thirdly, the contrast in location of different types of ridge may reflect abandonment at different periods, the highest land being abandoned before - perhaps well before - the late eighteenth century and the foothills remaining in tillage until after the period of levelling and straightening.

It seems unlikely that the degree of the contrast can be explained by the first two factors alone, the implication being that the furthest extent of cultivation in the study area was reached before the end of the eighteenth century.

Analysis of the survey: at the large scale

Yet it is at the larger scale that the landscape offers most valuable clues to the chronology of movement of the cultivation limit. It provides a framework for the relative dating of the reversion of arable which can be later incorporated into an absolute chronology by reference to the existing written record.

Space does not permit a report of the analysis of every parcel of abandonment. The general conclusions will emerge from the following chapters, but an illustration of the chronology for the Bedshiel area is presented as an example of the detailed conclusions which may be drawn from the survey of landscape evidence. The following summary refers to the area covered by the aerial photograph and overlay of Figure 4.6.

The location of head-dykes and unimproved land indicates that the maximum extent of cultivation was reached in this region at least before 1790. Moreover, the relative locations of the pre-improvement and post-improvement features suggests that there had been a widespread contraction of tillage before 1800. This contraction seems to have been common to all three farms, for their peripheral lands are generally not enclosed and exhibit crooked, high-backed ridges. The early abandonment was widespread, yet it does not seem to have been sufficiently great to have promoted an amalgamation of farms and desertion of steadings. Only one steading exhibits a traditional form which suggests its desertion before the end of the eighteenth century (settlement 5 on Figure 4.6).

The reduction in tillage seems to have continued over the period 1790-1860 for about 82 ha of arable land, which were abandoned before the first O.S. survey, were characterised by improved forms of cultivation ridge. The likelihood that this reversion was most prevalent in the early nineteenth century is indicated by two features. First, 11.5 ha of the land more recently abandoned exhibits Type 4 cultivation ridges. It has been emphasized that these probably indicate the continuance of tillage for only a short period after 1800. Secondly, it will be seen from

Figure 4.6 that two farmsteads (Weetfoot, GR 682519; Whiteknowe, GR 690530) are characterised by mixed pre- and post-improvement morphologies. These suggest their continued use for either a short time after 1800 or at a level of rent which would not reward large investments in rebuilding.

There is evidence, therefore, for the contraction of tillage in the Bedshiel area over the period 1800-1830 which may have been part of a continuous process between 1750 and 1860. There is certainly little evidence for the expansion of arable after 1780: the early head-dykes lie well above any signs of later cultivation. Since 1860 the reduction of improved land has continued until only the core of the farm at the extreme south-east corner of Figure 4.6 remained improved in 1970.

It will be evident from this example that landscape evidence provides a basis for the interpretation of broad trends in the movement of the cultivation limit for a century preceding the first edition of the Ordnance Survey. Analysis similar to that outlined above was made for the entire moorland core, and a broad chronology of advance and retreat by the limit of cultivation was thus established.

This chronology, which will serve as a framework for extrapolation from the more detailed but scant written record, may, however, be refined by the consideration of complementary evidence on the large-scale county maps of south-east Scotland. The latter will be discussed in the following chapter.

CHAPTER 7

DATING FROM THE EVIDENCE OF THE COUNTY MAPS

It has been noted that the only pre-Ordnance Survey map of the study area which illustrates the location of the limit of cultivation is the Military Survey of 1749-55. From a study of this survey it has been concluded that about 500 ha of land which were cultivated in the mid-eighteenth century were abandoned before 1860.

There is, however, a quantity of evidence on the county maps which points indirectly to the dates of reclamation and abandonment of cultivation. This includes the distribution of enclosure, and mention has been made of its spread into the periphery of the Lammermuir upland after 1790. However, since large areas of marginal arable land remained open until the mid-nineteenth century the limit of enclosure located on the county maps did not correspond to the limit of cultivation. Thus a more appropriate indicator of movement of the cultivation limit is change in the distribution of settlement.

EVIDENCE FOR THE DATE OF LAND ABANDONMENT

It has been suggested that the disappearance of 33 steadings from the map record can almost certainly be linked with the abandonment before 1860 of about 1,240 ha of cultivated land (supra p.123). The stage in the sequence of maps at which these steadings disappeared may reflect the date at which the land reverted. This hypothesis rests on a number of assumptions:

1. First, it assumes that the map record is comprehensive and the surveys for the maps can be dated with reasonable accuracy. These have been established in the preceding chapter.

2. Secondly, the degree of plagiarism between the surveys must be small, thus ensuring that few settlements which were abandoned after a survey were incorrectly located on later maps. This has been achieved through the selection of a limited sequence of maps which owe little to information already published at the time of their survey.

3. A third pre-condition is that a distinction may be made between those settlements which were the steadings of farms and those which were not related functionally to the tillage of adjacent land. This has been achieved through the elimination of mills and outbuildings from the analysis on aerial photographs of the morphology of settlement sites (supra 122).

Furthermore, it is important to establish the degree to which the surveyors of the county maps distinguished between steadings which were the foci for land use, and settlements which had become subordinate or secondary as a result of farm amalgamation. A study of the maps suggests that this distinction was made by the allocation of names to the steadings only; the farm-offices and secondary dwellings, if they were noted at all, remaining unnamed. The distinction is likely to have been made with care since the county maps were generally produced for a clientele of local landowners who were familiar with the district. This precision of settlement data was confirmed by comparison with a selection of estate plans, some of them surveyed by the authors of the county maps.

4. Fourthly, the dating of land reversion from changes in the settlement pattern assumes that parcels of abandoned tillage located from aerial photographs can be linked with specific sites of former settlement. It has been shown that such links can be provisionally established by a study of the landscape. Confirmation of the provisional association is discussed later in this chapter (infra p. 177).

5. Finally, the dating of land abandonment from the map record assumes that there is no long lapse in time between reversion of land and abandonment of the steading. This time lapse seems to have varied greatly according to the reason for, and thus the process of, the abandonment of settlement. In some cases there is evidence from manuscript sources and from the landscape for the wholesale abandonment of entire farms, resulting in the concurrent abandonment of the steading and the land. This occurred at Riddel Lodge (GR 526567; a/p: 58/RAF/3262: F61: 0213; RHP 1215/1) and at Twinlaw Vaults (GR 627544; a/p: 106G/SCOT/UK 9:5209-10). These and other farms abandoned en bloc in the early nineteenth century had often been established by planned and large-scale reclamation in the period 1750-70 rather than by piecemeal intake over a number of centuries. As planned units of reclamation they seem to have been more prone to abandonment en bloc than by stages.

It was more common, however, for the disappearance of steadings from county maps to be the product of the amalgamation of their land with that of adjacent farms. An amalgamated steading was often relegated either to the subordinate role of cottage or outbuilding, or to dereliction. The roles reflected stages in the decline of the building, and the speed of passage of the stages clearly determined the date of disappearance from the map record.

Changes of land use on the amalgamated farm seem to have been determined by changes in the status of the steading, although it is likely that a form of inertia operated to delay the effects of a degenerating steading on the intensity of adjacent land use. Thus, if the amalgamated or secondary steading retained a central function that was largely independent of the primary steading the changes in land use might be small. It seems to have been general, however, for the secondary steading to be swiftly relegated to a subordinate role. This is especially true for those farms near the moorland edge whose steadings were often not suitably located to provide a central service for the new farm unit. With the transfer of this function to the primary steading, land near the secondary steading now became peripheral to the reorganised farm, its role changing from infield to outfield or from outfield to moor, and in a short time land which had once been intensively farmed might revert to rough pasture. This chronology of contracting arable was noted to have occurred on some of the farms at Bedshiel (supra pp.157-9).

The process of farm amalgamation on the estates in the study area is discussed in Chapter 11; at present it is sufficient to note that abandonment of outfield normally occurred shortly after amalgamation, and that the date of reversion of infield was determined largely by its proximity to the functional centre of the new farm.

It may be concluded that there existed in the study area a functional correlation between the abandonment of high-lying steadings and the retreat of the limit of cultivation. The disappearance of steadings from county maps thus points to the location and date of land abandonment. The dating is accurate to within two decades and is adequate since it falls within the 20-year period that generally separates the stages of the map sequence.

EVIDENCE FOR THE DATE OF LAND RECLAMATION

It has been suggested that increases in the comprehensiveness of the county maps would make it invalid to infer the establishment of new steadings from settlements which appear mid-way in the map sequence. This is true for the earlier maps but it is clear that by 1768-73, the third stage in the sequence, the level of accuracy achieved is such that the later appearance of steadings near or above the contemporary limit of cultivation may indicate new farms and the reclamation of moor. Conclusions based on this evidence alone may be insecure, but they point to areas which would reward a close study of the written record. For this reason consideration is given not only to the disappearance, but also to the appearance, of steadings on the sequence of county maps.

CHANGES IN SETTLEMENT IN SOUTH-EAST SCOTLAND, 1600-1860

In this section consideration is given

1. to changes in the total number of steadings. These may reflect a broad chronology of land reclamation and reversion, and of farm amalgamation.

2. to the distribution of these changes in an attempt, first, to locate areas of intake and reversion and, secondly, to date the intake and reversion of land in these areas.

Changes in the number of steadings

Table 7.1 illustrates changes in the total number of steadings recorded on county maps for the study area. Only those settlements known to have been farm steadings and whose sites have been located with certainty by landscape and philological evidence are considered. Those for which the evidence of site and function exists but is inadequate are classified as 'not confirmed'.

The omissions and additions of steadings in the map sequence reveal an interesting trend. Up to 1770 additions far outnumber omissions owing to increases in the comprehensiveness of the surveys, although it is interesting to note that at least 35 steadings once existed in the study area but were abandoned before 1770. However, after 1770 omissions almost equal additions, suggesting that changes in their ratio may reflect real changes in the total number of steadings. Thus the substantial increase in omissions but reduction in additions in 1770-1800 suggests a phase of widespread abandonment of steadings, probably as a result of farm amalgamation (infra p.246).

Table 7.1

Changes in the number of steadings
in south-east Scotland, 1583-1648 to 1853-60

	established		abandoned		total	
	con-firmed	not con-firmed	con-firmed	not con-firmed	con-firmed	confirmed + not confirmed
c.1600 (1583-1648)	385	-	-	-	385	385
c.1600-1680 (1583-96 to 1682)[1]	28	-	2	1	411	410
c.1600-1750 (1583-1648 to 1749-55)[2]	284	-	12	7	657	650
c.1750-1770 (1749-55 to 1768-73)	136	-	21	6	772	759
c.1770-1800 (1768-73 to 1797-1810)[2]	85	-	72	3	779	769
c.1800-1825 (1797-1810 to 1824-38)[3]	96	-	54	-	821	811
c.1825-1860 (1824-38 to 1853-60)	60	7	70	3	811	805
		TOTAL	231	20		
		TOTAL	251			

1 East Lothian only
2 excluding Roxburghshire
3 Roxburghshire, 1770-1838

source: selected county maps

The increased ratio of additions to omissions in 1800-1825 suggests a decline in the pace of the abandonment of steadings although this seems to have accelerated once again in the 25 years prior to the first O.S. surveys in 1853-60. It may be postulated, then, that the amalgamation of farms, possibly associated with the abandonment of land, was less evident during and immediately following the Napoleonic Period than it was in the second quarter of the nineteenth century. This hypothesis may be tested by reference to the distribution of omitted steadings and to its correlation with the location of former cultivation.

Changes in the distribution of steadings

1600-1680

Figure 7.1 illustrates the distribution of steadings probably abandoned in East Lothian between 1600 and 1680. They are characterised by elevated and remote sites (297 m and 244 m O.D.) and are apparently associated with sites of former tillage exhibiting Type 1 cultivation ridges. The suggestion is that, during the century preceding 1680, reversion of isolated and high-lying arable occurred in at least part of south-east Scotland. It is not known whether this was widespread but it seems likely to have been the product of the abandonment of entire farms rather than of farm amalgamation.

Twenty-eight steadings appear on the manuscript map of East Lothian surveyed by Adair in about 1682 (NLS, A.10) which were not mapped by Pont over the period 1583-96. Their distribution, which is illustrated in Figure 7.2, cannot in any sense be taken as an indication of the location of farms established in the seventeenth century, since most of them are likely to be the product of difference in the accuracy of the surveys. It is interesting to note, however, that only two of the steadings are located with $\frac{1}{2}$ km of the moorland core and none is sited within it. The implication is that any new farms that were established between 1600 and 1680 were sited on lower land rather than at the moorland edge, and that there was little reclamation of land during the intervening period.

<u>1600-1750</u>

The distribution of 12 steadings which were abandoned between 1600 and 1750 is illustrated in Figure 7.3. All but three lay above 260 m O.D. and the remainder had extremely exposed sites on Coldingham Moor or St Abb's Head. Furthermore, while eight of the steadings were sited within or adjacent to the 1860-1970 moorland core, none is located more than 2 km from it. This concentration in remote and upland areas suggests that the disappearance of steadings was a product of, first, the abandonment of those farms which were least viable and, secondly, a general retreat by the cultivation limit rather than a more widespread amalgamation of farms. This conclusion is given weight by the evidence for associated reversion of arable land. Eight steadings, for which sites have been confirmed by evidence from aerial photographs and place-names, and two which are 'unconfirmed' (Fig. 7.3), can be linked provisionally with the contemporary abandonment of cultivation (supra p. 123). The implication is that the period 1600-1750 may, in upland south-east Scotland, have been characterised by a retreat of settlement and cultivation.

The pattern of steadings which appear on the county maps for the first time during the period 1600-1750 (Fig. 7.4) is almost certainly determined by the increased detail of the Military Survey. But it is likely that, while only eleven settlements (4 per cent) were sited within the moorland core, some of these were the steadings of new farms and were associated with reclamation from moorland. Yet the main increase in the number of steadings occurred at some distance from the contemporary limit of cultivation, for those settlements which first appear on the Military Survey are concentrated in low areas - on the northern periphery of the region, in central Lauderdale and between Coldingham and Duns. Of the higher parts of the study area only the Stow Uplands are well represented. The upper valleys of the Whiteadder and Dye Waters, which are known to have been quite closely settled by the seventeenth century, exhibit only small increases in settlement over 1600-1750 (Fig. 7.4).

A more thorough analysis of the pattern may not, however, be rewarding since much of it may be the product of spatial differences in the accuracy of the surveys of Pont, Blaeu and William Roy.

1750-1770

More than 21 steadings were abandoned in the study area between about 1750 and 1770. Their distribution is shown in Figure 7.5. Fewer were sited on the Lammermuir plateau than were in 1650-1750 and only seven were located within or adjacent to the moorland core. This suggests that they may be the result more of the beginnings of farm amalgamation than of the abandonment en bloc of marginal farms.

However, about eight steadings, including two for which the evidence is not conclusive, seem to be associated with sites of former tillage. Of these, two (Gainsmuir, GR 638657; Skar Hill, GR 718622) may be the product of wholesale abandonment rather than of amalgamation.

Increases in the accuracy of the county maps continue to account for the pattern of steadings appearing between 1750 and 1770 (Fig. 7.6). This exhibits an almost even scatter throughout the farmed part of the study area. There are, however, slight regional variations which may reflect patterns of real change. First, there seems to have been little new settlement established in the valleys of the Whiteadder and its tributaries. Secondly, only eight steadings (6 per cent) lie within or immediately adjacent to the moorland core and, of these, two (Weetfoot, GR 682519; Kippet Law, GR 688541) might well have existed in 1750 but do not appear on the Military Survey owing to inadequate surveying of the Dirrington region. Thus only six steadings (Riddel Lodge, GR 526567; Huntershall, GR 471585; Rammerside, GR 640716; (not named), GR 850693; (not named), GR 853705; Rampart Hall, GR 914693) possibly represent areas of reclamation in the moorland core during the period 1750-70. Of these, only the first three exhibit evidence on the landscape which confirms this date of intake. Riddel Lodge (or Dod House, as it was renamed after about 1820) is characterised by an extensive layout with an improved morphology that does not appear to overlie an earlier pattern. This suggests the establishment of the farm as a planned unit, rather than as a product of more piecemeal intake, just before 1770. It represents, however, the only example in the study area of high-level reclamation on a large scale in the mid-eighteenth century. The general impression is one of an overall balance between small quantities of intake and reversion at the periphery of the 1860-1970 moorland core.

1770-1800

Figures for the sum of appearances and omissions of steadings have suggested that in 1770-1800 the reversion of improved land more than balanced the quantity of reclamation in the study area. The spatial pattern of settlement, however, offers two reasons for modifying this conclusion.

First, of the 72 steadings abandoned in the late eighteenth century (Fig. 7.7) only about twelve lie within or adjacent to the moorland edge, and, according to the landscape evidence, only three are certainly associated with sites of former cultivation (Oldtown, GR 854697; not named, GR 856690; Wardknowe, GR 430573).

Most of the steadings which disappeared in 1770-1800 were located in the lower sectors of the study area and seem to have become redundant after the widespread amalgamation of smaller farms in the intervening period. This suggestion is confirmed by a number of reports in the Statistical Account of Scotland in 1791-99 (infra p.250). It is not likely, then, that extensive reversion of farmland would have accompanied their abandonment.

Secondly, the distribution of first appearances of settlement in 1800 may closely reflect the establishment of new steadings, owing to the level of comprehensiveness achieved in the county maps by the end of the eighteenth century. This distribution suggests that many of the new steadings were linked with reclamation inside or at the periphery of the moorland core. It is evident from Figure 7.8 that reclamation was particularly extensive on Coldingham Moor where a commonty was divided in 1776, on the poorly drained platform at Westruther, at the foot of the escarpment in Gifford, and at the edge of Fala moor. It is interesting to note that, once again, there was little intake in the south-eastern valleys which had been closely settled in the medieval era.

Much of the advance of cultivation in the late eighteenth century seems to have been excessive, for a number of the new steadings and their associated cultivation were abandoned before the 1850s: Wardknowe (GR 430573), Twinlaw Vaults (GR 627544), Snawburn (GR 701486). Some of the intakes remained improved until after 1860 but, having lost their steadings through amalgamation, were less extensively farmed after about 1800 (Blawearie, GR 476599; Salvandi, GR 443592). The majority of the remaining high-lying steadings and intakes were abandoned after 1860.

Thus, in contrast to the preceding century, the evidence from settlement suggests that the final third of the eighteenth century represents a phase of extensive reclamation in the study area.

<u>1800-1825</u>

Fewer steadings were abandoned in the early nineteenth than in the late eighteenth century but abandonment appears to have been especially prevalent near or within the moorland core (Fig. 7.9). Indeed, the landscape evidence suggests that the disappearance of at least seven steadings was associated with reversion of arable, a point which will be considered in greater detail in the next section (infra p.187). The implication is that, whereas the abandonment of settlement in 1770-1800 was the product of farm amalgamation, in 1800-25 it seems to have been more a direct result of retreat by the limit of cultivation.

Figure 7.10 illustrates the distribution of new settlement between 1800 and 1825. Most of the steadings were established on the Stow Uplands, on the divided commonty at Coldingham and on the Duns uplands. This suggests that the trends which may have operated before 1800 became more marked in the early nineteenth century: reclamation may have taken place in the south-west and south-east sectors almost to the exclusion of other parts of the study area. There seem to have been few new settlements established in the valleys of the Whiteadder and Dye Waters or north of the Lammermuir Edge.

1825-1860

The retreat of the cultivation limit seems to have been accelerated in the second quarter of the nineteenth century. Of seventy steadings abandoned between 1825 and 1860, twenty lie within or immediately adjacent to the moorland core (Fig. 7.11), and there is prima facie evidence on the landscape that suggests a close correlation with land reversion, much of it occurring in the area between Longformacus and Greenlaw.

Most of the new settlements in the moorland core were steadings for hill sheep farms, and were not normally associated with reclamation for cultivation. However, one farm (Yadlee, GR 654676) was established on new inbye land at 260 m O.D. on part of Dunbar Common which had been divided in 1833 (Riddell, 1833) (Fig. 7.12).

Outside the moorland core, settlement and reclamation was concentrated on the apportioned plots of Coldingham Moor, where fourteen smallholdings were established. There was also limited intake of the mosses at Gordon and Greenlaw, and of the high moorland on the Stow Uplands, yet this was small in comparison with the advance of cultivation earlier in the century. Once more, there is little sign of new settlement in the south-eastern valleys and on the northern escarpment.

Summary

Some conclusions on the advance and retreat of the cultivation limit in the study area may be drawn from this consideration of changes in settlement:

1. In the seventeenth century abandonment of settlement and reversion of farmland was widespread in the high-lying areas of upper Lauderdale and of the south-eastern valleys. This does not seem to have been balanced by an upward advance of cultivation elsewhere.

2. Retreat of settlement continued up to the first half of the eighteenth century. It was apparently a product of abandonment of marginal farms rather than of amalgamation of holdings.

3. Over 1750-70 the process of abandonment slackened. The amalgamation of farms on lower land was initiated and there is evidence for increased reclamation in the moorland core.

4. In 1770-1800 there was active reclamation within the moorland core, on the Stow Uplands and on the eastern Lammermuirs. Amalgamation of farms was widespread.

5. In 1800-25 the advance of cultivation slowed, with the exception of the Stow Uplands and the Coldingham area. Abandonment in the moorland core reappeared.

6. Over 1825-50 abandonment became more widespread and reclamation was limited to the uplands at Stow, the mosses near Gordon and to areas released for improvement by divisions of commonty.

Throughout this broad chronology there runs a marked contrast between, on the one hand, the retreat of settlement from the valleys of the Whiteadder and Dye Waters and from the foothills in East Lothian, and on the other hand, the continued reclamation of moorland in the area above Stow and on the hills between Duns and Coldingham.

DATING CHANGES IN LAND USE FROM CHANGES IN SETTLEMENT

The relation of cultivation to settlement sites

Since there is, in the study area, a broad correlation between changes in land use and changes in settlement, it is possible to estimate the date of intake and reversion of land known to have been associated with steadings which appear in or disappear from the sequence of county maps.

Up to this point the association between cultivation plot and settlement site has been only loosely established by a study of the relict landscape, but the procedure may be refined by reference to contemporary patterns of land ownership and land holdings. This ensures that links between steadings and cultivation are drawn within rather than across boundaries of estates and farms. Unfortunately no comprehensive maps of these boundaries are available before 1947. Information exists for limited areas on estate plans, and parish totals of estates and farms are available in the Statistical Account of Scotland (Sinclair, 1791-99) and in the Inventory of Records of the Presenter of Signatures' Office (SRO, Exchequer Series, E.901). But apart from parish boundaries which are a broad indicator of early divisions of land ownership, there is little to tie such abstract data to specific locations.

The gaps between the estate plans may, however, be sketched in with the help of more recent information. It is possible to locate and map holdings and ownership boundaries for the entire study area for 1947 from manuscript maps held by the D.A.F.S. and from contemporary land valuation rolls. This map of farms and estates may be used as a base for the reconstruction of the pattern of land ownership in 1870 (from agricultural returns and land valuation rolls) and in 1791-98 (from the Statistical Account of Scotland). These in turn provide a locational framework for abstract summaries in the Exchequer rolls of 1771-72. The procedure is discussed in Chapter 11 (infra pp.357-8).

Thus the pattern of land holdings and land ownership may be established for those areas, comprising about one-third of the study area for which a coverage of estate plans is extant. But for the intervening areas a less accurate pattern may be traced, first, from the nineteenth-century framework, secondly, by reference to the quantity of farm amalgamation and, thirdly, by a study of parish boundaries and natural features. The result is a pattern of farms and estates in 1771-72 from which the association between plots of former cultivation and sites of abandoned settlement can be more firmly established than by a study of the landscape evidence alone. The change of steadings in the sequence of county maps is thus made a more precise indicator of the date of both abandonment and reclamation of arable land.

The date and location of reclamation and abandonment, 1600-1860

By reference to the pattern of farms and estates in 1771-72 and 1791-98 a number of settlement sites were related, with some confidence, to areas of abandoned cultivation; and the continued evidence from the relict landscape and from the county maps enabled the reclamation and abandonment of these areas to be dated to one of five periods: 1600-1750, 1750-70, 1770-1800, 1800-25, 1825-60.

Reclamation can be identified in those areas linked by the patterns of land ownership to steadings which appear for the first time in the sequence of county maps. But the dating of these intakes cannot often be supported by landscape evidence and the reliability of the map evidence for 'new' settlement is suspect, particularly before 1770, owing to increases in the accuracy of the surveys. For these reasons the distribution and, particularly, the quantity of reclamation summarised in the following discussion can be considered only an approximate indicator of the real trends. The quantity of reclamation probably associated with the new steadings is given in Table 7.2

The evidence for abandonment is, however, more reliable and may be confirmed by a study of the type of cultivation ridge and the morphology of the settlement site. But such supporting evidence is available only for permanent abandonment within the moorland core. The mapping and dating of temporary reversion in areas where the landscape was modified by secondary reclamation are less securely based.

With these reservations in mind, it may be noted that the abandonment of 35 steadings between 1600 and 1860 was certainly associated

Table 7.2

Steadings established and land reclaimed, 1750-1860

	within moorland core		outside moorland core	
	no. steadings	associated reclamation (ha)	no. steadings	associated reclamation (ha)
1750-70	4	176	25	993
1770-1800	5	141	26	998
1800-25	9	126	40	2,814
1825-60	5	69	35	1,238
TOTAL	23	512	126	6,043

with reversion of 610 ha of cultivation. The association between a further 16 steadings and 425 ha was not confirmed. The dating of this abandonment is summarised in Table 7.3.

The names and location of these steadings associated with the abandonment of land, and the area of abandonment, are given in Appendix I. Similar details for the establishment of steadings and reclamation of farm land are summarised in Appendix II.

The distribution of reversion and reclamation, and that of their related steadings, is illustrated for each of the five periods in Figures 7.13-25.

Table 7.3

Abandoned steadings and abandoned land, 1600-1860

	confirmed association		unconfirmed association	
	no. steadings	abandonment (ha)	no. steadings	abandonment (ha)
1600-1750	6	75	7	149
1750-70	5	62	2	22
1770-1800	7	91	2	76
1800-25	8	186	2	54
1825-60	9	196	3	124
TOTAL	35	610	16	425

1600-1750

Figure 7.13 illustrates the probable limit of cultivation in about 1600 and 1650. It is based on the edge of moorland illustrated on the Military Survey (1749-55), modified by the distribution of steadings on the maps of Pont and Gordon and by the distribution of pre-improvement ridges mapped from aerial photographs outwith the moorland core (supra p. 93). More than 49,600 ha (37.8 per cent of the study area) is likely to have been reclaimed before the mid-seventeenth century. It is evident that cultivation had advanced well up the higher slopes of Lauderdale, the south-eastern valleys and the northern scarp. Yet broad belts of land on the Upper Merse, on the Stow Uplands and on the exposed eastern Lammermuirs seem not to have been settled. Thus the general impression is of settlement and agriculture established well within the moorland core and lying well above outliers of unreclaimed land.

The distribution of reclamation between 1650 and 1750 (Fig. 7.13) is based on the location of cultivation on the Military Survey at sites for which there is no indication of earlier settlement. The pattern can thus be considered no more than approximate, and the distribution is certainly not complete. It suggests, however, that in the intervening century there was little intake from the high moors and in the long-settled areas: only three new sites, totalling not more than 15 ha, lie in the moorland core. By contrast reclamation seems to have concentrated on the exposed and ill-drained areas avoided by earlier settlement. Two exceptions to this were the consolidation of previous gains near Gifford and the upward advance of agriculture in Innerwick and Oldhamstocks.

The total intake in the study area may not have exceeded 4,400 ha. Indeed, the century is likely to have seen a retreat by the highest limits of settlement and cultivation for there is evidence for the permanent abandonment of farms in the moorland core and for the temporary but widespread reversion of improved land in the foothills of the Lammermuirs. Six steadings, which disappeared from the map record between 1650 and 1750 and whose sites have been identified from aerial photographs, can be almost certainly linked with the abandonment of 75 ha of cultivation (Fig. 7.14). The names of these steadings, their location, altitude and the quantity of cultivation probably associated with their abandonment are given in Appendix I.2. Seven more steadings suggest the permanent reversion of a further 150 ha. These figures are unlikely to represent the entire abandonment during the period, but it is reasonable to suppose that at least 5 per cent of all the abandoned land mapped from aerial photographs in the moorland core reverted in the late seventeenth and early eighteenth centuries. It is evident from Figure 7.14 and Appendix I.2 that the sites of reversion are characterised by either exposed locations (Coldingham Moor, St Abb's Head) or by high altitudes. At Over Tullus (GR 523585) cultivation extended beyond 425 m O.D. Nine of the thirteen settlement sites stood above 245 m O.D., the implication being that the limit of cultivation withdrew in 1650-1750 from locations climatically least favourable to cereal husbandry.

The temporary reversion of tillage, reclaimed after 1750, seems to have been particularly widespread. It may be identified from areas of dense settlement portrayed by Pont and Gordon which are characterised by moorland on the Military Survey. The cartographic evidence cannot be confirmed on the landscape and the quantity of abandonment, about 2,220 ha, may not be accurate. Yet its distribution, illustrated in Figure 7.15, is probably reliable. This exhibits concentrations on the upper slopes of Lauderdale and of the Whiteadder and Bothwell Waters at elevations of 250-300 m O.D., and on the exposed eastern Lammermuirs. The lack of abandonment below the northern scarp is particularly marked. Both this distribution and the quantity of reversion relative to the small areas of intake support the contention of a widespread and, in some areas, lasting retreat of agriculture from the climatically marginal areas of former settlement.

1750-1770

Figure 7.16 locates probable areas of reclamation in the third quarter of the eighteenth century. These have been identified from the pattern of steadings which appear on the county maps of 1768-73 at locations which were evidently not settled at the time of the Military Survey. Of the 284 steadings which first appear in 1770, at least 29 are likely to have been associated with the intake of moor. Their names and locations are listed in Appendix II.1, and the sites of those lying within the moorland core are illustrated on Figure 7.16.

The extent of reclamation associated with these new farms can be gauged from the pattern of land ownership and the distribution of moorland in 1750. It seems to have exceeded 1,150 ha which would have represented a 2 per cent increase in the area of improved land between 1750 and 1770, had there occurred no corresponding reversion elsewhere. Most of the new farmland seems to have been taken in from the Stow Uplands, the Westruther platform and the exposed eastern foothills. Of especial note is the establishment of a new farm with more than 140 ha of improved land at 365 m O.D. in eastern Lauderdale. Apparently reclaimed in error of judgment, it was abandoned en bloc before 1860.

The advance of cultivation in the southern sector of the study area is balanced by a continued retreat of agriculture and settlement in the south-eastern valleys. Of five steadings which were certainly associated with land abandonment three lie in the valleys of the Whiteadder, Bothwell and Monynut Waters (Fig. 7.17). At least 60 ha (Appendix I.3) or about 2 per cent of the former cultivation within the moorland core reverted in 1750-70, more than three-quarters of this lying above 245 m O.D. The suggestion is that the abandonment of upland farms, which was characteristic of the period 1600-1750, continued at a reduced rate into the latter half of the eighteenth century.

It is not possible to assess the quantity or distribution of temporary reversion but it seems likely that this was widespread for it may be reflected by the extent of land (c.2,480 ha) which was cultivated in 1750 but classified as rough pasture in 1860 (Fig. 7.18).

1770-1800

After 1770 the cartographic evidence for reclamation becomes more reliable. Of 85 steadings established between 1770 and 1800, 31 were evidently associated with an intake of about 1,140 ha of new farmland (Appendix II.2), the equivalent of a 2 per cent increase in the area of improved land. Of this intake, only 141 ha were located within the moorland core and account for less than 3 per cent of the arable abandoned before 1860. Yet the elevation of the reclamation is surprising. At three sites in the moorland core aerial photographs reveal that the intake of moorland extended beyond 335 m O.D. and at Twinlaw (GR 627544) to 373 m O.D. Elsewhere reclamation appears to have concentrated at elevations of 275-335 m O.D. in the Stow Uplands, at 200-230 m O.D. on Quixwood Moor, and at Coldingham, where it was consequent on division of the commonty in 1776. The absence of reclamation in the south-eastern valleys and to the north of the Lammermuir Hills is once more outstanding (Fig. 7.19).

Permanent reversion over 1770-1800 was more scattered than in earlier periods (Fig. 7.20). Most abandonment continued to be of old-established settlement, but at least one site (Wardknowe, GR 430573) reflected the reversion of land reclaimed not more than thirty years earlier. The short life of new farm land in the moorland core was a feature which became increasingly common in the early nineteenth century (see Chapter 11).

The disappearance of nine steadings can be linked with the abandonment of more than 160 ha of arable comprising about 3 per cent of former cultivation within the moorland core (Appendix I.4). A further 63 settlements were, however, abandoned during the same period. These are scattered throughout the study area (Fig. 7.7) and the widespread amalgamation of farms which these may reflect is likely to have been associated with the temporary reversion of arable. The extent and distribution of this reversion cannot be precisely assessed but it is not likely to have been widespread at a time of extensive upland reclamation (Fig. 7.18).

The conclusion is that the late eighteenth century in south-east Scotland saw the diminishing abandonment of marginal cultivation and a corresponding increase in the extent of upland reclamation. The upward advance of improved land continued, however, to be concentrated in certain sectors of the study area. There is little evidence for the re-intake of arable which had reverted in the preceding century.

1800-1825

At least nine farms were established in the moorland core between 1800 and 1825. These may have been linked with the intake of about 125 ha of rough pasture, amounting to 2.5 per cent of the total area once cultivated within the core (Appendix II.3). Yet little of this reclamation occurred at a high level.

A further forty new steadings can be linked with the reclamation of more than 2,800 ha of farmland from the moors on the southern Stow Uplands and Billiemire Gap, and from the Westruther and Gordon platforms (Fig. 7.21). A proliferation of small holdings on the divided moor at Coldingham suggests continued intake in this region also. There appears to have been some activity north of the Lammermuir Hills and in the south-eastern valleys but a sectoral advance of the limit of improved land is still very much characteristic of the pattern of reclamation. The total intake of moorland in the study area would probably have exceeded 5 per cent of the land farmed at the turn of the century.

It is evident, however, that there occurred a corresponding increase in the permanent abandonment of high-level farmland. The disappearance of ten steadings is almost certainly associated with the reversion of about 240 ha of cultivation in 1800-25, representing almost 5 per cent of the former arable in the moorland core (Appendix I.5).

Moreover, most of the abandonment occurred at a high level (Fig. 7.22), a third of it above 305 m O.D., which suggests that it reflects a retreat of cultivation from least favourable locations, rather than farm amalgamation. About one-sixth of the reversion was of land probably reclaimed after 1650 while the remainder was of long-established agriculture.

Temporary abandonment is likely to have been more widespread than in the preceding period and may comprise much of the distribution for 1750-1860 illustrated in Figure 7.18. The evidence on the landscape and map record is, however, inconclusive. A more precise analysis of temporary abandonment must await the study of manuscript and published sources (Chapter 8).

The general impression of trends in marginal agriculture over the period 1800-25 is one of both increasing sectoral advance and of accelerating retreat from the highest and most isolated areas.

<u>1825-1860</u>

Of sixty settlements which appear on the map record for the first time in 1853-60, forty appear to be associated with the intake of at least 1,300 ha for cultivation (Appendix II.4). This corresponds to about 2 per cent of the extent of improved land in 1825. Fourteen of the new farms were small holdings which were established at the periphery of Coldingham Moor and which led to the reclamation here of about 320 ha of rough pasture. Further concentrations of intake occurred at Quixwood Moor, Billiemire Gap, Gordon and Stow (Fig. 7.23) - the traditional sectors of advance in the eighteenth century.

Yet the extent of the advance over 1825-60 was less than that of the preceding 25 years, and over the same period the pace of abandonment accelerated. Evidence from the landscape and the map record suggests that up to 320 ha of permanent reversion accompanied the disappearance of 12 steadings before 1860 and accounts for 6.5 per cent of the abandonment of former cultivation in the moorland core (Appendix I.6). Moreover, a further eight steadings which were abandoned after 1860 appear to have been linked with about 270 ha that reverted in 1825-60 (Appendix I.7). Thus the area which fell back to moor in 1825-60 may have comprised more than 11 per cent of the sum of abandoned cultivation found in the moorland core of the study area.

Much of this reversion occurred on the slopes above the tributaries of the Whiteadder and Dye Waters (Fig. 7.24) and represents a late phase in the abandonment of areas settled before A.D. 1600. Also prevalent, however, was the retreat of cultivation from areas that had been won from the moor not more than a century earlier. This is evident at Dod Hill in Lauderdale initially reclaimed in 1750-70 and at Coldingham Moor which was taken in after 1776.

Rough pasture which lay outwith the moorland core in 1860 and was later reclaimed totalled 13,900 ha. However, it is evident from the foregoing discussion that 66 per cent (c.9,220 ha) of this area had been cultivated before 1860. It thus represents a zone of temporary reversion. Of this 2,480 ha (27 per cent) may be tentatively designated as abandoned in 1750-1850 (Fig. 7.18) but the remainder cannot be assigned to any period and a proportion of it may have reverted before 1750. It is not possible, therefore, to assess with precision the quantity of arable land that returned to rough pasture in the period 1825-60. The suggestion is, however, that a large part of the moorland in 1860 which had formerly been under cultivation had been quite recently abandoned.

It may be concluded that the sectoral advance of improved land slowed in the second quarter of the nineteenth century, and that increases in both permanent and temporary reversion of farmland resulted in a general retreat of cultivation from the periphery of the moorland core.

Conclusions

It has thus been possible, through convergence of evidence from the map record, from the morphology of cultivation ridges and from associated features on the relict landscape to estimate, first, the date of reclamation and reversion of cultivation and, secondly, the location, extent and timing of advance and retreat by the moorland edge. It is important, however, to recognise the limitations of the procedure.

First, the chronology of accurate and independent maps for south-east Scotland allows trends in the cultivation limit to be dated only approximately.

Secondly, confirmation of the maps by aerial photographs and field survey can be positive only in the study of permanent abandonment. Its corroboration of evidence for temporary reversion and for reclamation is only partial. While the distribution of abandoned land which has been confirmed by alternative evidence may thus be regarded with confidence, the dating of reclamation can be considered only tentative.

Thirdly, it should be recognised that, in spite of the advantage of increased comprehensiveness over manuscript sources, the evidence on county maps enables only a proportion of the total change in land use to be identified and dated. Thus 38 per cent (35,000 ha) of the initial recla-mation, 79 per cent (3,855 ha) of the permanent abandonment and 47 per cent of the temporary reversion of land in the study area cannot be allocated to any specific period after 1600. The areas of intake or reversion in any period are thus unreliable. It is possible, however, for the areas of undated intake and abandonment to be classified as 'pre-improvement' or 'post-improvement' according to their form of cultivation ridge, settlement site and enclosure pattern. This indicates that 8 per cent (2,820 ha) of the undated reclamation first occurred before 1770, and at least 1.7 per cent (590 ha) between 1770 and 1860. Over the remaining area the landscape evidence has been removed by recent cultivation. All that may be said is that it had been reclaimed before 1860.

Similarly 32 per cent (1,230 ha) of the undated abandonment in the moorland core can be allocated with some confidence to a period 1800-60, the remainder being pre-improvement. Of the latter, it may be possible to identify abandonment before A.D. 1600/1650. The sites of several steadings which are clearly associated with abandoned land have been identified on aerial photographs and in the field but do not appear on any of the county maps (Appendix I.1). With the exception of Quixwood Moor (Fig. 7.25), where there seems to have occurred a secondary intake after 1800, cultivation ridges on the associated land are of a pre-improvement type and the suggestion is that a number of these settlements may have been abandoned before 1600-50 or, if overlooked in the surveys by Pont or Gordon, at least by 1750.

Some conclusions may be drawn from the foregoing discussion:

1. Prior to 1600 settlement and agriculture had advanced to surprisingly high levels, especially in Lauderdale (max. 365-425 m O.D.) and the south-eastern valleys (max. 305-365 m O.D.). There may have been some permanent abandonment of these elevated sites in the sixteenth and seventeenth centuries.

2. Over the period 1600-1750 widespread permanent and temporary abandonment continued in those areas where the frontiers of settlement had over-advanced. Limited reclamation occurred at lower sites which had been avoided by earlier improvement.

3. In 1750-70 the rate of reversion was reduced and that of intake accelerated, particularly at Stow, Westruther and Coldingham. With abandonment and reclamation probably balanced, the synoptic limits of cultivation were stationary.

4. Over 1770-1800 sectoral advance became more marked and reversion less widespread.

5. Over 1800-25 sectoral advance accelerated but was increasingly balanced by the reversion of high-lying farmland. The abandonment of recent intakes as well as of old-established settlement was characteristic of the south-eastern valleys.

6. Over 1825-60 synoptic limits of cultivation retreated due to increased reversion and reduced intake. The sectoral pattern of both reversion and intake remained marked.

Discussion of the more recent movements of the moorland edge has shown that in the late nineteenth century these spatial patterns were maintained while the trends of change were reversed. Extensive reclamation over 1860-96 and 1953-70 was concentrated on the Stow Uplands, although it was not possible to distinguish between primary and secondary reclamation from Ordnance Survey maps (supra p.34). With a knowledge of the quantity of intake before 1860 it is now possible to note that 5625 ha (38per cent) of the reclamation between 1860-1970 represented the intake of previously uncultivated moor. Its distribution (Fig.12.2) was also concentrated in the traditional sectors of advancing improvement. The remainder of the reclamation over 1860-1970 was secondary intake of abandonment which had occurred largely in the period 1800-60.

Moreover, reference to the retreat of improved land since 1860 has indicated that the reversion of farmland continued to focus on those areas in which the uphill advance of early settlement was over-extended - the south-eastern valleys and upper Lauderdale. It is interesting to note, however, that abandonment was also particularly prevalent on the intakes of former commonties (Innerwick, Chirnside and Coldingham) and on the Gordon and Westruther platforms which seem to have been marginal to cultivation throughout the last three centuries.

The broad trends which have governed locational changes in the upper limit of cultivation have thus been identified by reference to changes in settlement on the map record and to evidence on the relict landscape. The correlation of evidence from these two sources has increased the accuracy of both the mapping and the dating. Yet their greatest value is their spatial comprehensiveness which has enabled the construction of a chronological framework for the entire study area. It has thus been possible to define with sufficient accuracy the balance of total reclamation and abandonment and, particularly, their location and the consequent patterns of advance and retreat by the limit of cultivation.

In the following chapter more precise but more fragmentary sources will be analysed in an attempt to establish a more detailed chronology for selected areas. With control from the new framework, the results of these analyses may be extrapolated over the study area with a greater confidence than might otherwise be possible.

CHAPTER 8

THE CHRONOLOGY OF CHANGE: THE MANUSCRIPT, PUBLISHED AND STATISTICAL EVIDENCE

The chronology of movement of the cultivation limit can be refined by reference to selected written records, both published and manuscript. An analysis of these sources aims to test the conclusions of the preceding chapters and, where possible, to date more accurately the advance and retreat of cultivation. A more precise dating of these changes will point to underlying and associated trends, and will help to explain both the spatial pattern of the limit and the chronology of its movements.

Some of the associated trends may themselves be valuable indicators of the chronology of change. For example the occurrence of plague or the falling price of grain may, with some accuracy, point to periods of retreat of upland cultivation. Their use as indicators, however, assumes a causal connection that has yet to be established. Thus consideration will be restricted as far as possible to independent evidence, both direct and indirect, of changes to upland tillage.

It is clear that throughout the period 1600-1900 there occurred changes fundamental to farming in upland south-east Scotland. Innovation in type of crop, in rotations, fertilizers, drainage, implements of tillage, as well as changes to common land and the pattern of holdings were bound to be reflected as changes in productivity. The productivity of land and labour determined in part the extent of tillage, and it is misleading to deal with movement of the limit of cultivation without reference to qualitative changes in the system of cultivation per se.

It is convenient, however, to defer a consideration of qualitative developments in farming and to limit the present chapter to a study of spatial change. This being the case, it is important to bear in mind that widespread changes in the nature, and particularly the intensity, of cultivation were often contemporaneous with phases of locational change.

A variety of evidence for change in location is considered chronologically under the following sub-headings:

The late medieval base-line
Retreat and consolidation: 1600-1750
The improvement and war-time agriculture: 1750-1815
Post-war consolidation and re-advance: 1815-60
Continuing trends: 1860-1900

THE LATE MEDIEVAL BASE-LINE

The period with which this study is primarily concerned is 1600-1860, defined by the earliest accurate map and by the first edition of the Ordnance Survey of south-east Scotland. The maps of Pont (1583-96) and Gordon (1636-48) thus provide a convenient base-line for a chronology. However, it is important for two reasons to bear in mind those changes in the limit of cultivation that may have occurred between A.D. 1000-1600: first, it is valuable to date the early reclamation of upland arable land that later reverted in the seventeenth century. This enables a distinction to be made between the abandonment of recent and of long-standing cultivation, these being quite different responses to underlying socio-economic change. Secondly, it is valuable to be aware of those changes in agriculture that occurred in the late medieval period. If there did occur a retreat of cultivation before 1600, as the evidence from maps and the landscape suggests (supra p.191) then some of the abandoned land mapped from aerial photographs is a relic of this period. If this land may be dated to the late medieval period then the quantity of outstanding, undated abandonment is reduced and some confusion in seeking a date for its reversion after 1600 is avoided. In the following section, therefore, consideration is given briefly to reclamation and reversion of farmland in the Middle Ages.

Pre-medieval settlement

It has been suggested that the mould-board plough was not introduced to south-east Scotland before the ninth or tenth centuries A.D. The evidence for this is not conclusive but it suggests that cultivation ridges are unlikely to have been associated with Iron Age or Roman settlement. It is, however, important to eliminate any uncertainty over this issue for it has been suggested that some hill forts in East Lothian were occupied up to the seventh century A.D. (RCHM(S), 1924: xxxvi).

An examination of the distribution of Iron Age hill forts and brochs plotted by Feacham (1966), and of Roman sites mapped by the Ordnance Survey (1956) reveals no correlation between these and the location of former cultivation. This confirms, first, that the cultivation ridge is post-Iron Age and, secondly, that the mapping from aerial photographs has not confused cultivation ridges with those narrow ridges constructed by the ard in Romano-British times and which occur near some Iron Age settlements.

Berwickshire and East Lothian were brought under Anglian influence from Northumbria after about A.D. 630. Northumbria consolidated its power over much of southern Scotland in the eighth and ninth centuries (RCHM(S), 1967: I:4) and it is possible to trace Anglian occupation of the Borders from the place-name evidence (Nicolaisen, 1964). The number of names with a typical Old English suffix which occur along the waters of Gala and Leader, and between Coldingham and Haddington, suggest that Anglian settlement spread from the south along the coast and up the larger valleys in the study area.

But it is not possible to assess the quantity of land reclaimed before A.D. 900. Cultivation terraces seem to have been introduced into Scotland by the Angles (RCHM(S), 1967: I:39) and these are particularly common in southern Roxburghshire where some stand at elevations exceeding 455 m O.D. Yet only three groups of terraces have been located in the study area: Brotherstone (GR 436554), Barnside Hill (GR 677627) and Heriot Siding (GR 395571) (Graham, 1938-39).

~~Danish influence in the ninth~~ century seems to have been limited and not until after A.D. 950 is there an indication of settlement, and associated tillage, in the upland of the study area (Johnston, 1940: 11). At this time the southern advance by the Scots of Dalriada seems to have been accompanied by quite widespread settlement through East Lothian and Berwickshire. Johnston (1940: 11) thought that at least seventy place-names in Berwickshire were celtic in origin. A number of these are located at elevation in the study area and may reflect the origins of upland settlement and agriculture. The highest sites are listed in Table 8.1. Most are recorded as granges or steadings in the early monastic period and are likely to have been associated with cultivation not more than 250 years after the period of Scottish hegemony.

Table 8.1

Place-names of celtic origin

name	parish	GR
Caldra	Longformacus	702572
Carfrae	Channelkirk	501551
Cribb Law	Lauder	525597
+Cribbes	Oldhamstocks	707667
+Dimples	Longformacus	690556
Dronshiel	Longformacus	707556
Glengelt	Channelkirk	479555
Kilpallet	Whittingehame	629606
Monynut	Oldhamstocks	738645
Penshiel	Whittingehame	642632
Tollis Hill	Lauder	519579

+obsolete

source: Johnston (1940)

The early medieval advance

Yet there is little doubt that widespread settlement and reclamation in the Lammermuir Hills was delayed until the beginning of the Norman infusion in the eleventh and twelfth centuries when large blocks of land in the Borders were granted for settlement to southern lords by David I (1124-53), Malcolm IV (1153-65) and William I (1165-1214). An early illustration of this colonisation is the grant of Aedenham (Ednam, Berws.) in a condition of waste (desertam) to Thor Longus, a north Englishman. Thor settled the area, built a church and endowed it with a ploughgate of land, and gave church and land to the monks of St Cuthbert (Durham). By 1150 Ednam Church had been transferred as a possession to the Priory of Coldingham (RCHM(S), 1915: xviii).

At the same time were being founded abbeys, nunneries, hospitals and collegiate churches which later acquired grants of land throughout southern Scotland. The dates of foundation and dissolution or secularisation of those religious houses which possessed lands in the study area are illustrated in Table 8.2. From these it is clear that the origins of monastic influence on settlement and agriculture in south-east Scotland date from the third and fourth decades of the twelfth century, a period which is characterised by organised settlement and reclamation on the Haddington plain and in the Lower Merse. From these centres the reclamation of farmland seems to have advanced onto the Upper Merse toward the foothills of the Lammermuirs. An indication of the pace and direction of this movement is given by the appearance of parish churches, which is likely to reflect, as it did at Ednam, the consolidation of settlement

Table 8.2

Religious houses which possessed lands in the Lammermuir area

	date founded	date dissolved or secularised
Monasteries		
Kelso	1128	1607
Melrose	1136	1609
Coldingham	1139	1606
Dryburgh	1150	1606
May	1153	c.1318 (transferred to Pittenweem)
Nunneries		
Haddington	pre-1159	1621
St Bothan's	13th c.	1622
Hospitals (located in the study area)		
Soutra	1164	1583-4
Lauder	c.1170	?
Legerwood	pre-1177	?
Oldcambus	pre-1214	?
Duns	pre-1274	?
Bara	pre-1340	?
Dunglass	pre-1480	?
Cockburnspath	pre-1511	?

source: Easson (1957)

and recent gains from the moor. Thus it is evident from Table 8.3 that by about 1170 the peripheral lowlands and even the valleys in the study area had been reclaimed and settled on a scale that warranted the erection of a parish church.

From here, in response to demand for land both in the monastic and in the secular sectors of the economy, reclamation seems to have advanced rapidly into the foothill zone. Indicators of this movement are available in the records of the Border abbeys, and a brief consideration is given to these to determine the approximate limits of cultivation that had been established by the early medieval period. It should be emphasised that the advance of secular cultivation is likely to have been as rapid as that on abbey lands but secular sources tend to be less abundant than monastic, and their collection thus lies outwith the scope of this study.

The upward movement of monastic agriculture was tied closely to the receipt by abbeys of large grants of upland. A study of the charters of the Border abbeys indicates that such grants were frequently bestowed over the period 1150-1250, after which they became more scarce (Liber de Melros, 1837; Romanes, 1917; Liber de Dryburgh, 1847; Liber de Calchou, 1846; Registrum de Soltre, 1861; Registrum de Neubotle, 1849; Raine, 1841).

Within a century the abbey lands achieved their maximum extent. Their location can be traced from place-names in the charters of the grants and in abbey rentals:

> The rentale of the Abacie of Melrose pertenying presentlie to the Abbot ... 1576 (Romanes, 1917: 140-146)

Table 8.3

Dates of granting and dedication of parish churches

	appropriation	date of granting	date of dedication
East Lothian			
Garvald and Bara	Haddington	late 12th c.	
Humbie	Kelso	c.1160	
Oldhamstocks		pre-1127	
Stenton (Pitcox)	Dunbar		
Whittingehame	Haddington	pre-1458	
Yester (Bothans)			1241
Berwickshire			
Abbey St Bathans	St Bothans		
Bunkle and Preston	Dunkeld	late 11th c.	
Channelkirk	Dryburgh		1241
Cockburnspath and Oldcambus	Coldingham		
(Coldingham	Durham	1139	)
Duns	Dunbar Collegiate Church		
Gordon	Kelso	c.1171	1242
Greenlaw	Kelso	1147	1242
Langton	Kelso		1242
Lauder	Dryburgh		
Legerwood	Paisley	1127	1242
Longformacus and Ellem			1242
Polwarth			1242

sources: RCHM(S), East Lothian, HMSO, Edinburgh, 1924
RCHM(S), Berwickshire, HMSO, Edinburgh, 1915

Rentale of Dryburgh, c.1535 (Liber de Dryburgh, 1847, Appx.28; 330-338)

Rotulus antiquus redituum monasterii de Kelso, 1300 (Liber de Calchou, 1846: 455-470)

The rental of Neubotle ... (no date) (Registrum de Neubotle, 1849, Appx.3: 325-335)

The confirmation of place-names in early charters by these later rentals provides an accurate picture of the distribution of monastic possessions in about 1300 (Fig. 8.1). On these possessions the monasteries set about reclaiming the moor and establishing permanent settlement (Coulton, 1933: 121-22). The pace of reclamation must have been rapid for the early rentals indicate that certainly by about 1300 most of the lands had been organised into baronies held by the monks _in dominico_ and cultivated from the major granges (Liber de Calchou, 1846: xxxii). A grange of Kelso at _Spertildon_ (now Gammelshiel, GR 649648) which stood at 300 m O.D. contained in 1300 two carucates (c.108 ha) of tillage, 1,400 sheep and sixteen cottages for shepherds and their families (Liber de Calchou, 1846: 465). At Blainslie on the eastern Stow Uplands cultivation was already extensive by 1170, indeed the demand for ploughland seems to have been sufficiently strong to invoke strictures against further assarting of the woods above the grange (Charter Nos.110, 111, Liber de Melros, 1837). From similar evidence of the extent of tillage on abbey land it is clear that, although the upland granges were largely devoted to livestock, cultivation was a permanent feature of the farming system (Liber de Calchou, 1846: xxxii-xxxiii). Thus the distribution of monastic possessions illustrated in Figure 8.1

is an indication of the limits to which cultivation and settlement had advanced by about 1300.

It is clear that by 1300 tillage had advanced from the Lower Merse to the summits of the southern Stow uplands (Fig. 8.1). At Allanshaws (Alenshawis), Wooplaw (Vowplaw) and Ladhopemoor (Ladopemure) it may have reached 300 m O.D.; and in the central Lammermuirs on the other granges of Melrose at Kingseat (Kingsyd), Penshiel (Pansheills), Friardykes (Freirdyks) and Wintersheildykip it almost certainly exceeded 300 m O.D. (Fig. 8.1). The farms of Soutra Hospital at Upper Brotherstone and Gilston, and of Kelso at Dirrington, Gammelshiel and Bothwell point to similar levels of settlement and agriculture. Indeed, the suggestion is that in several areas the limits of cultivation which were reached in the Middle Ages were never exceeded in the following centuries. At Williamlaw (GR 474399, 275 m O.D.), Allanshaws (GR 492438, 320 m O.D.) and Dirrington (GR 686555, 270 m O.D.) there are areas of pre-improvement ridge and furrow which were certainly abandoned before 1800 and have not since been reclaimed. The suggestion is that these lands were cultivated in the early medieval period but abandoned over the following five hundred years. The possibility of their abandonment in the late medieval period, before 1600, is discussed later.

The evidence for cultivation at elevation on secular lands is less secure. It has been suggested that, while lay landlords did encourage reclamation, 'the monasteries were incomparably richer, and at first more farsighted, than any but the most exceptional layman; and therefore it is to them that we owe most of the clearings' (Coulton, 1933: 120). Yet such evidence as there is suggests that there existed on the periphery of the Lammermuirs quite large lay estates in the early thirteenth century. Addinston (Aldeniston) and Dod Law (Todlaw?) are mentioned in a charter of 1222 and Tollis Hill (Tolchus), which stands at 365 m O.D., in one of 1252 (Graham, 1948-49). Tollis Hill is apparently associated with a large area of abandoned tillage that extends above 425 m O.D. In addition, Burncastle (275 m O.D.), Collielaw (230 m O.D.) and Carfrae (275 m O.D.) in upper Lauderdale are referred to as secular lands in charters which are not dated but are probably of thirteenth century origin (Charter Nos.183, 185, 191, Liber de Dryburgh, 1847).

Shieling sites

Yet the uplands of south-east Scotland were more extensively used for livestock ranching than for tillage and, although an examination of the improvement of land other than by the plough lies outwith the scope of this study, it is instructive for two reasons to consider the distribution of shieling sites during the monastic period. First, it may point to the location of tillage associated and contemporary with grazing and, secondly, because many shielings tended to develop into sites of more permanent settlement, they may reflect the origins of the highest tillage in the study area.

Manuscript evidence points to the extent of the grazing rights held by the Border abbeys. Melrose held rights of pasture over the whole of the southern Stow Uplands up to the present Roxburghshire-Midlothian boundary (Hardie, 1942: 74). North of this, Soutra held the moors at Fala between Brotherstone and Dere Street (Barrow, 1960: 244), and much of the reclamation of land at Brotherstone and Gilston was probably for winter fodder for the large numbers of sheep and cattle herded on Fala Moor (Charter Nos.162-67, Liber de Dryburgh, 1847). Both Melrose and Kelso were granted large pastures in Lambermor, probably on Dunbar Common (Charter No.77, Liber de Melros, 1837). The shielings of Bothwell (Bothkill) granted to Kelso before 1160 covered about 1,000 acres (405 ha) (Franklin, 1952: 66).

It is not easy, however, to locate these shielings precisely. The identification of place-names with a '-shiel' suffix cannot be comprehensive and may reflect sites which were not used in the early middle ages. Certainly the term '-shiel' is of Norse origin (Johnston, 1940: 11) and, when attached to a Gaelic prefix, as in Dronshiel (GR 707556) and Penshiel (GR 642633), it may be indicative of pre-medieval livestock farming. But the charters of the Border abbeys suggest that the shieling system was an integral part of medieval agriculture and that the term was used loosely to represent the upland pasture for sheep and cattle. Although some shieling sites may have originated in the tenth or eleventh centuries, it is therefore likely that most continued in use over the monastic period.

Figure 8.2 illustrates the distribution of '-shiel' place-names in the study area found, first, on county and Ordnance Survey maps and, secondly, in monastic and lay charters. It suggests a concentration of sites in the eastern Lammermuirs, particularly on the slopes above the upper Bothwell, Whiteadder and Dye Waters. Much of these uplands thus seem to have been heavily grazed, and their development from sites of shielings into those of more permanent settlement and perennial stocking may have occurred at an early period (viz., Wintershiels, GR 670685).

The completeness of the distribution can be increased by reference to the relict landscape. In 1913 seven bothies were evident on Lamb Rig in north Lauder (GR 536594) (M'Conachie, 1913: 193), and the RCHM(S) inventories indicate what may either be the remains of bothies or cottars' dwellings near Johnscleugh on Lauder Common (GR 631664) and at Braidshawrig (GR 581529) (RCHM(S), 1924: xl; RCHM(S), 1915: 122). A further five probable sites were identified on aerial photographs and checked in the field:

site	parish	GR
Foulburn Bridge	Polwarth	717516
Crystal Rig	Innerwick	664672
Fala Moor	Fala and Soutra	423589
Boonslie	Innerwick	671706
Harecleugh Rig	Westruther	627537

Conclusion

The early medieval era is peripheral to the chronology of this study and has been only briefly examined. However, some preliminary observations suggest that:

1. Much of the cultivation and many of the steadings which were abandoned in 1600-1860 were established in the early monastic period. Their abandonment thus represents the retreat of a long-standing limit of cultivation, not the reversion of recent and temporary intakes.

2. Settlement and tillage was functioning at a surprisingly high level, often over 300 m O.D., in the early medieval era. Indeed there seemed to be increasing pressure in the twelfth century for reclamation of the high moors, while areas in the Upper Merse and on the foothills were apparently avoided.

3. In some parts of the study area cultivation seemed to advance to a limit not exceeded in later centuries, the suggestion being that some of the abandoned tillage mapped from aerial photographs was farmed in this early period.

Retreat of cultivation in the late medieval period?

Evidence from abandoned settlement

A small number of farms mentioned in early monastic charters cannot be traced on maps of the period 1600-1860. This may be due to changes of place-name but the possibility of their abandonment before 1600 cannot be overlooked. Only those known to have been located within the study area are listed in Table 8.4, and it should be emphasised that time did not permit a thorough search of all extant charters. The twelve steadings were noted during the collection of other material and, in view of the small proportion of charters that yielded these names, the total number of sites in the study area might be considerably larger.

Only one of these names (Williamelaw, GR 474399) can be correlated with certainty with a site of abandoned settlement plotted from aerial photographs (Fig. 7.25). This site is closely associated with abandoned cultivation ridges of the pre-improvement type and it seems probable that some retreat of tillage accompanied abandonment of the steading between 1576 (Table 8.4) and the date of the Military Survey (1752-55). However, the suggestion that a number of the undated sites on Figure 7.25 may be the product of abandonment before 1600 must remain unconfirmed.

Table 8.4

Abandoned steadings mentioned in monastic charters
and not recorded on county maps

name	date mentioned	approximate location	reference
Alwins land	c.1155	Kedslie (Melrose) GR 554405	Charter No.110, Dryburgh Charters
Herdesley	c.1160	Kedslie (Melrose) GR 554405	Charter No.112, Dryburgh Charters
Milchside	c.1188	Blainslie (Melrose) GR 548431	Hardie, 1942: 75
Williamelaw	1576	Williamlaw (Melrose) GR 474399	Rental, 1576 Melrose Charters: 141
Quytwel	c.1238-1300	(Humbie?)	Charter No.34, Soutra Charters
Johnystoun	c.1250	Johnstounburn? (Humbie)	Charter No.36, Soutra Charters
Paistoun	c.1189-1214	(Humbie?)	Charter No.8, Soutra Charters
Ouchiltre	c.1201-1233	(Humbie?)	Charter No.16, Soutra Charters
Maxpoppill	1576	Stow Uplands	Rental 1576, Melrose Charters
Cambeston and Ptewland	1576	Stow Uplands	Rental 1576, Melrose Charters
Buklawis	1576	Stow Uplands	Rental 1576, Melrose Charters
Newgrange mylne in Lamermure	1576	?	Rental 1576, Melrose Charters

Further evidence for a retreat of cultivation in the late medieval period lies in the quantity of abandoned cultivation ridges associated with steadings known to have flourished in about 1300 (viz., Dirrington, Penshiel and Mayshiel). The suggestion that, in these areas at least, the limits of cultivation achieved their highest level at this time implies abandonment not long after this date.

An interesting occurrence which supports the hypothesis of a decline in agriculture at this time is the wasting of hill peat at Penshiel (GR 639627, 335 m O.D.) to reveal old cultivation ridges. This suggests that the abandoned ridges were covered by advancing peat during the deterioration of climate in the fifteenth to seventeenth centuries and have been re-exposed by the reduction of peat due to a modern amelioration. The possible relation of climatic change to shifts of the limit of cultivation is discussed at length in Chapter 10.

Indirect evidence

The indirect evidence for a retreat of settlement and agriculture before 1600-50 rests upon assumptions of a causal link between decline in cultivation and a number of known occurrences of the late medieval era. It would be unwise to place much reliance on them, but a number of associated factors may be mentioned in connection with the early retreat of upland tillage.

First, the alienation of lands from the monasteries may have led to less capital-intensive systems of farming. After 1531 the imposition of heavy taxes drained the monasteries of their resources and accelerated the 'feuing'[1] of abbey lands to raise money. This gradual 'self-dissolution'

1. Feu-holding: a heritable tenure, granted in return for a fixed and single rent, and for certain casualties.

proceeded throughout the sixteenth century so that by 1580 a large proportion of former monastic land was held by lay lords. Thus all the possessions of Melrose in the central Lammermuirs (Kingseat, Penshiels, Friardykes, etc.) were feued to George Lauder of Bass by 1556 (Romanes, 1917: 237-45). In a similar way the Cistercian nunnery at Haddington made over much of its property in Yester and Garvald in 1580 to Lord Lindsay of Byres (Harvey and MacLeod, 1930: Charter No. 832A).

Secondly, there was disruption of the regional economy by repeated invasion. Both monastic and lay settlements suffered heavily at the hands of English armies in 1297-1300, 1461, 1490, 1497, 1499, 1542 and 1544-49 (Easson, 1957: 34, 77, 122; Gibson, 1905: 5). The report of Hertford's invasion (1544-45) for 27th September 1545 runs

> Went through the Merssheland, which is very plentiful of wheat, barley and oats, for 20 miles in length and 8 or 9 in breadth, destroying houses, towers, corn, cattle, herb and peel till nothing remains but the towers of the lairds of Langton, Fermyhurst, and two or three others who are sworn English and protected by the lieutenant and council
>
> RCHM(S), 1915: xxiv from Letters and Papers, Henry VIII, xx, ii: 200

In the same month 49 'towns' were burned in Duns parish and at least 41 near Greenlaw including several near the limit of cultivation which may have caused the abandonment of tillage (Gibson, 1905: 24).

Yet the calamity may have been less than reports suggested. Sir Ralph Eure, referring to a similar destruction in 1542, remarked:

> Ther was dyvers of thes townes afornamyd in the Merse dystroid this last yere with the armye. Notwithstanding the same townes ar byldite and planyshid as they were before.
>
> RCHM(S), 1915: xxv

Nevertheless the Exchequer Rolls indicate that in 1497 and 1499 the lands were so wasted that either they were not laboured or the crops were destroyed (RCHM(S), 1915: xxv). Persistent discouragement such as this, particularly to marginal upland farmers, may have led to a decline in cultivation. It certainly accelerated the process of alienation of monastic lands for the loss of rents from pillaged granges and the debts incurred in reparations were often balanced by feuing large possessions. In 1549 the lands of Langshaw and Housebyres in the Stow uplands were feued by the monks of Melrose to James Hopringle of Smailholm 'on consideration of monies paid to them in their urgent necessity and for the use of the monastery now burnt by the English and to be applied in repairing the same ...' (Elibank Papers, GD 32/22/2).

Thirdly, and complementing mortality in war, was the loss of about a third of Scotland's population to the Black Death between 1349 and 1401. Thus, while increases in population in the twelfth and thirteenth centuries must have contributed to a shortage of agricultural land, by 1400 the previous balance between men and land had been dramatically upset (Smout, 1969: 40). There is likely to have been, especially in those uplands least attractive for settlement, a surplus of land and a shortage of labour. Unfortunately the limited research on medieval Scotland allows only a guess at the implications of these occurrences for the use of marginal land.

A fourth factor possibly associated with abandonment of tillage in the late medieval period was the deterioration of climate, which may have led to increasing difficulties in cereal cropping at high levels. This is discussed in Chapter 10.

Conclusion

While evidence for the retreat of cultivation before 1600-50 is scant, there is some indication, first, of a disappearance of upland settlement over the period 1200-1600 and, secondly, of economic and political conditions that might have encouraged the abandonment of land. The subject deserves more thorough research than this study can afford. It must suffice to say, however, that there may be support for the beliefs of some early writers that cultivation in south-east Scotland was in the thirteenth century both more 'flourishing' and, in some areas, more extensive than in 1800 and that 'there must have been a miserable falling off in succeeding times' (Robertson, 1829: 2).

In the following sections evidence for the date of change in the upper limit of cultivation is discussed under two headings: first, the direct evidence for land-use change, which is available from estate plans, from contemporary published accounts, and from estate manuscripts; secondly, the indirect evidence for land-use change which is available from a study of changes in steadings and of associated trends in the rural economy.

RETREAT AND CONSOLIDATION: 1600-1750

The period 1600-1750, defined by Pont's maps and by the Military Survey, opens with the union in 1603 of the English and Scottish crowns, which brought political stability to the Scottish borders, and closes on the eve of widespread acceptance of improvements to agriculture in the study area. It thus conveniently embraces a phase which saw the inception of commercial farming and the changes that this, in turn, brought to the limit of cultivation in the uplands of south-east Scotland.

It has been noted that in the medieval era cultivation advanced to high levels in Lauderdale and the south-eastern valleys. In the valleys it seems to have been associated with perennial agriculture and the permanent settlement of early shieling sites. Some of the shielings had been established at the periphery of common lands to take advantage of rights of pasture over large sections of the eastern Lammermuirs, and reclamation by the later steadings on these sites was often an illegal encroachment on common land (Riddell, 1833: 3-4). The origins of high-level settlement thus seem to lie in the twelfth or thirteenth centuries.

Whatever the quantity of abandonment in the late medieval period much of the highest cultivation remained in use in 1600. At a lower level, however, large stretches of ill-drained moor between Legerwood and Greenlaw, at Coldingham and on Quixwood Moor were unsettled (Fig. 7.13). In 1600 there thus existed both high-level cultivation and low-lying moor, and over the following 150 years the suggestion is that reversion of upland tillage and reclamation of the low moors worked to rationalise what had once been a confused pattern of the cultivation limit. In the following section an attempt is made to refine the dating of these trends.

The direct evidence for land-use change

Manuscript estate plans

Owing to the late arrival of the agricultural revolution in Scotland the region is poorly endowed with early estate plans. South-east Scotland is no exception and has no plans pre-dating 1740. It is fortunate, however, in having a broad coverage of seven plans over 1748-65 (Fig. 8.3). These may be compared with evidence on the relict landscape to point to changes over the period 1600-1750. For example, the omission of cultivation from one of these plans for an area characterised by unimproved cultivation ridges suggests abandonment of tillage before 1750; or the representation of this area on a plan as 'fine pasture' points to quite recent abandonment that would have allowed insufficient time for reversion to full moorland.

The only indication of advancing cultivation in this period is at the foot of the northern scarp in Whittingehame where two steadings were established between 1596 and 1759 (GR 617732; RHP 2515: 1759). Elsewhere reversion seems to have been widespread, particularly over 1730-1760. On Greenlaw Moor the steading of Fangers disappeared and its associated tillage was abandoned between 1731 and 1765 (GR 500497; RHP 224/1: Grinley Moore, 1731), and at Bedshiel and Weetfoot on the Marchmont estate the coincidence of pasture with unimproved cultivation ridges points to the abandonment of about 93 ha shortly before 1765 (GR 682519; Marchmont House: Marchmont, 1765). It is interesting to note that the correlation between the distribution of cultivation on the plans and the patterns interpreted from aerial photographs confirms the accuracy of the initial mapping.

At the upper Bothwell Water two steadings, Knowis and Birkcleugh, were amalgamated between 1596 and 1776 (GR 671663; RHP 10005: Harehead, 1776). Most abandonment of adjacent land occurred, however, in the 1780s and 1790s, and points to amalgamation of farms in the mid-eighteenth century. On the Blackcastle estate in Innerwick the highest outfields reverted and a steading was abandoned shortly before 1753 (GR 710700; RHP 2514: Blackcastle, 1753). Some of the new moor was reclaimed once again before 1823, but most of the reversion was permanent. At Lauder there was widespread abandonment of steadings and land over 1740-60 and some secondary reclamation after 1770 (GR 550510; RHP 3683: Lauder, 1756).

The high levels of cultivation suggested by Pont in 1596 are thus confirmed by the coverage of estate plans. Both temporary and permanent reversion of tillage accompanied by a limited abandonment of steadings seem to have occurred between about 1700 and 1750 in the highest and most remote areas, generally above 230 m O.D. The trends over 1600-1700 remain uncertain.

Contemporary published accounts

Contemporary descriptions of changes in the extent of cultivation are scarce. There is a suggestion in the Reports on the State of Certain Parishes in Scotland, 1627 (MacGrigor, 1835: 44) that liming had allowed 'the cultivation of more outfield more frequently' (Smout and Fenton, 1965). Sir Robert Sibbald writing in 1698, perhaps more of Fife than of East Lothian or Berwickshire, noted that there was 'a vast deal of ground now tilled and laboured that before was pasture' (Smout and Fenton, 1965), and the report for Yester in the New Statistical Account written in 1835 stated that 300 acres (121 ha) of moor 'might be reclaimed - a considerable proportion having been under the plough in the reign of Queen Anne' (NSA: II: 162). Yet a contraction of tillage in the 1690s was opined by a commentator in 1811

> Those who are acquainted with the state of Scotland at the end of the seventeenth century, need not be informed, that the distressed situation of the husbandman at that time, from a series of bad crops and adverse seasons, was the sole cause why farms were frittered down to a small size, - the tenantry being quite unable to stock or cultivate a farm of any considerable extent
>
> (Farmer's Magazine, 1811: 68)

Among the advisory writers of this period Donaldson (1697: 33-52) recommended laying two-thirds of the outfield down to grass, and Hamilton (1713: 21-22, 23) advised the manuring and liming of about half the outfield and the appropriation of the remainder to sheep. Increases in productivity were thus designed to offset the contraction of tillage.

The suggestion from both published accounts and estate plans is, then, that the limit of cultivation advanced after 1600, but that this advance was checked by a run of poor seasons in the 1690s. Retreat of cultivation occurred at high level over the period 1700-50.

Estate manuscripts

No specific mention has been found in extant manuscripts of reclamation or reversion of cultivation over the years 1600-1750. There is a reference to planting and dyke construction at Kyles Hill (GR 727497) which may point to the reclamation of part of Greenlaw Moor in the 1740s (GR 727497; RUL, BERW 1/2/1: Marchmont Labour Book, 1746-50); and at Yester there is frequent reference to enclosure after 1660 and to liming in the 1690s which points to changes in productivity in the seventeenth century (Harvey and MacLeod, 1930: Charter Nos.1777 (1663), 1802 (1664), 1912 (1665), 2253 (1698).

Perambulations and divisions of commonty

Reports of perambulation and processes of division of commonty record encroachments of tillage which may reflect an extension of cultivation. The distribution of these commons is discussed later (infra p.363).

A charter of 1631 noted that the boundaries of the commonty of Dunbar passed alongside 'the arable and corn-field lands' of Kirkcleugh (Birkcleugh, Spott) and Johnscleugh (Whittingehame) (Riddel, 1833: 5). These lands coincide with plots of unimproved cultivation ridges mapped at about 300 m O.D. from aerial photographs. Moreover Birkcleugh disappears from the map record between 1596 and 1755 and its site exhibits an 'unimproved' morphology. The conclusion is that these high arable areas were cultivated at least up to 1630 but were abandoned before 1750.

Furthermore, a perambulation of 1680 noted on the north side of the common some unused dykes which inspection in the field (GR 666703) has indicated were contemporary with adjacent unimproved cultivation ridges. Thus both dykes and cultivation, which lie at 300 m O.D., seem to have been abandoned before 1680. However the same perambulation reported encroachments at Benty-dod (Beltondod, Spott) 'where the lands being tilled and buildings erected', at Leehouse and Rammerside (Whittingehame) and at Rottenraw (Stenton) (Riddel, 1833: 6). At Rottenraw there is a close correlation between the site description of the encroaching tillage and the location of unimproved cultivation ridges mapped from aerial photographs. In the eastern Lammermuirs, therefore, there was evidently both reclamation and reversion of arable, the reversion perhaps occurring in the late seventeenth or early eighteenth centuries.

At Chirnside Common five perambulations (Craw, 1922) from 1607 to 1679 reported near Quixwood, Whareburn, Blackburn and Luckieshiel, widespread encroachments which survive as pronounced unimproved cultivation ridges in moorland (GR 774645, 754650). About 184 ha of Quixwood Moor exhibit signs of former cultivation which dates back at least to the early seventeenth century. The sites of eight dwellings, probably cottars' houses, seem to be associated with much of this cultivation (Fig. 7.25), though no mention of illegal building is made in the perambulations. This may point to temporary settlement and tillage on the commonty prior to 1607.

The indirect evidence for land-use change

Evidence from changes in steadings

Inadequate sources for the direct dating of advance and retreat of cultivation may be supplemented by a study of changes to settlement. A variety of sources were examined in an attempt to date more precisely the establishment and abandonment of upland steadings which might have been associated with the intake and reversion of arable land.

Sources These sources included chronological series of rentals for the estates of Dunglass in Cockburnspath and Coldingham (RUL, Dunglass, EAS 1), Innerwick and Thornton in Innerwick (SRO, Biel, GD 6), Belton in Dunbar and Spott (SRO, Hay of Belton, GD 73) and part of the estate of North Berwick in Lauder (SRO, Hamilton-Dalrymple, GD 110).

Reference was also made to miscellaneous charters included in the collections of 34 families known to have at one time possessed lands in the study area. Of these, five collections contained references to changes in steadings in the study area over 1600-1750 (Roxburghe, NRA(S) 0179; SRO, Elibank, GD 32; SRO, Buchan-Sydserff of Ruchlaw, GD 1/494; SRO, Yester, GD 28 and NRA(S) 0439; SRO, Airlie, GD 16).

Finally, the Geographical Collections by Walter MacFarlane which include accounts of East Lothian and Berwickshire written in about 1649 (Mitchell, 1908), and the Reports on the State of Certain Parishes in Scotland made in 1627 (MacGrigor, 1835) were consulted for information on settlements existing in the early and mid-seventeenth century.

Abandonment of steadings A study of these sources enabled more precise conclusions to be made concerning both the number of steadings abandoned over 1600-1750 and the date of their abandonment. A summary of these conclusions is presented in Table 8.5. Of the 14 steadings which disappeared from the map sequence in this period, one was mentioned in the Reports of 1627 and a second in a charter of 1720. Evidently the settlements were abandoned after these dates but before the Military Survey.

Table 8.5

Date of abandonment of steadings, 1600-1750

name	last date of reference	area (ha) of associated permanent abandonment of land	approx. location (GR, or nearest farm and parish)	reference
1. ON PONT/BLAEU BUT PREVIOUSLY NOT LOCATED:				
*Muirburne	1690	-	nr Hopes (Yester)	SRO, Yester, GD 28/2194
*The Kimellis	1627	-	Oldhamstocks	MacGrigor, 1835: 101-4
*Parkzit (Parkyet)	1587	-	Cockburnspath	SRO Dunglass, GD 206/1/6
*Birks	1627	-	Humbie	MacGrigor, 1835: 121-4
*Reidhall (Rydhall)	1627	-	Soutra	MacGrigor, 1835: 64-9
*The Pelcleugh	1627	7	737547	MacGrigor, 1835: 16-19
*Pitcherlaw	1627	29	nr Pelcleugh (Langton)	MacGrigor, 1835: 16-19
*Welcleugh	1627	7	733519	MacGrigor, 1835: 16-19
*Shorttoprig	1627	-	nr Welcleugh (Langton)	MacGrigor, 1835: 16-19
		TOTAL: 43 ha		

(remainder for which no reference found: not named, Start-Up, Karram, Rogertlaw, Mansley)

* located on Figure 8.4

Table 8.5 (contd)

name	date	area (ha)	location	reference
2. ON PONT/BLAEU, PREVIOUSLY LOCATED:				
*Handaxwood (Handaeswood)	1720	21	626577	Roxburghe, NRA(S) 0179: 1/41/6
*Cribs (Cribbes)	1627	5	709663	MacGrigor, 1835: 101-4
		TOTAL: 26 ha		
3. NOT ON PONT/BLAEU:				
Paddowclewche	1587	-	Cockburnspath	SRO, Dunglass, GD 206/1/6
Rawchenside (Rachensyd)	1627	-	Cockburnspath	MacGrigor, 1835: 101-4
Rownetrie Hauch	1627	-	Humbie	MacGrigor, 1835: 121-4
Westhouse	1627	-	Humbie	MacGrigor, 1835: 121-4
Miskourie	1606	-	Yester	SRO, Yester, GD 28/1033
Akiesyde	1654	-	Whittingehame	SRO, Buchan-Sydserff, GD 1/494/17
Belsibus	1606	-	Whittingehame	SRO, Yester, GD 28/1033
Munkland of Yester	1606	-	Yester	SRO, Yester GD 28/1033

* located on Figure 8.4

Table 8.5 (contd)

name	date	area (ha)	location	reference
Wodefute	1606	-	Yester	SRO, Yester, GD 28/1033
*Little Heirtoun	1580	-	nr Carfrae	SRO, Yester, GD 28/832a
Waltreeshott	1690	-	Yester	SRO, Yester, GD 28/2194
Spottscheill	1620	-	Spott	Roxburghe, NRA(S) 0179:1/9
*Doighous	1723	-	nr Howbog, Cranshaws	SRO Swinton, GD 12/233
*Thornieburne	1723	-	nr Howbog, Cranshaws	SRO, Swinton, GD 12/233
*West Mure(?)	1601	-	nr Johnscleugh, Whittingehame	SRO, Swinton, GD 12/171
*Eistraik	1619	-	nr Housebyres, Melrose	SRO, Elibank, GD 32/22/4
*Fosterhauche (Fosterhaugh)	1599	-	nr Boon, Legerwood	SRO, Airlie, GD 16/24/28
Leitheid	1588-9	-	Lauder or Westruther	SRO, Airlie, GD 16/37/57
Byarnot	1588-9	-	Lauder or Westruther	SRO, Airlie, GD 16/37/57
*Todhoillis	1588-9	-	nr Earnscleugh, Lauder	SRO, Hamilton-Dalrymple, GD 110/355

* located on Figure 8.4

Table 8.5 (contd)

name	date	area (ha)	location	reference
Little Igrop	1588-9	30	nr Earnscleugh, Lauder	SRO, Hamilton-Dalrymple, GD 110/355
*Pluckbie	1588-9	-	nr Earnscleugh, Lauder	SRO, Hamilton-Dalrymple, GD 110/355
*Wintershiels	1654	-	670684	SRO, Buchan-Sydserff, GD 1/494/17
Haw-wood	c.1649	-	Coldingham	MacFarlane's Geog.Coll.183
Hornend	c.1649	-	Coldingham	MacFarlane's Geog.Coll.183
Coldsyde	c.1649	-	Coldingham	MacFarlane's Geog.Coll.183
Haven	c.1649	-	Coldingham	MacFarlane's Geog.Coll.183
*The Kibos	1627	10	nr Middle Monynut, Oldhamstocks	MacGrigor, 1835: 101-4
Klovis	1627	-	Cockburnspath	MacGrigor, 1835: 101-4
Tempill	1627	-	Bunkle and Preston	MacGrigor, 1835: 1-4
Wyndone	1627	-	Bara	MacGrigor, 1835: 104-5

* located on Figure 8.4

Table 8.5 (contd.)

name	date	area (ha)	location	reference
Spairs Houses	1627	-	Bunkle and Preston	MacGrigor, 1835: 1-4
*Craehouse	1627	-	786514	MacGrigor, 1835: 16-19
Badsburn	1627	-	Langton	MacGrigor, 1835: 16-19
Wauchtone Craqha	1627	-	Abbey St Bathans	MacGrigor, 1835: 23-24
*Redcleugh	1746	-	Auldcambus, Cockburnspath	RUL, Dunglass, EAS 1/2/23
*Hazelton	1746	-	Auldcambus, Cockburnspath	RUL, Dunglass, EAS 1/2/23
		TOTAL: 40 ha		

* located on Figure 8.4

Moreover, of 14 steadings marked by Pont and Blaeu but which could not be located by place-name or landscape evidence, nine were named in a variety of sources. The dates of last reference to these names are listed in Table 8.5. Two were certainly extant in 1690, one in 1587 and the remainder in 1627. At least three were probably associated with abandonment of cultivation over the same period, the area of abandonment totalling about 43 ha. Some of the settlements can be located by reference to other place-names mentioned in the same documents, and it is evident that all but three of the nine steadings were sited within 1 km of the 1860-1970 moorland core.

It is thus clear that most of the settlements marked by Pont and Blaeu but omitted by the Military Survey, were deserted after 1627, some of them after 1690. Their sites were often high and remote and it is thus likely that their desertion was linked with the reversion of upland tillage over the same period.

The charters and rentals contained references to 37 other settlements in the study area which were neither on the maps of Pont and Blaeu nor on the Military Survey. Their approximate locations and the date of most recent reference to them are presented in Table 8.5. Twenty-six were last named before 1628, six in the 1650s and the remainder after 1689. At least four were associated with abandonment of land and most seem to have been situated in the upland part of the study area, although the sites of only 13 may be precisely located.

It is evident, therefore, that at least 60 steadings were abandoned between the 1580s and 1750, of which only 14 appear on the sequence of county maps. The date of last appearance in the charters and rentals may be summarised as follows:

date	no. of steadings
1587-1620	16
1627	19
1649-54	6
1690	2
1720	3
1746	2
	TOTAL 48 (+12 undated)

It is thus possible to postulate with some certainty the abandonment of one-sixth of the settlements after 1690, almost one-third after 1650, and almost two-thirds after 1627, the implication being that abandonment of steadings was more common in the second than in the first half of the period 1600-1750.

The location of these steadings is illustrated in Figure 8.4. If the pattern is not severely biased by the nature of the sources, the suggestion is that abandonment was concentrated in the south-eastern valleys at elevations of 245-380 m. This strengthens the hypothesis of a retreat from areas of over-extended medieval settlement.

The quantity of land abandonment associated with these trends cannot be accurately gauged, but it is probable that at least 109 ha of former cultivation evident on aerial photographs were linked with nine of the steadings (Table 8.5); and since most of the steadings were sited in high and remote areas it is likely that much of their arable land would have reverted to moor rather than have been worked by an adjacent farm.

Amalgamation of farms It has been suggested that amalgamation of farms has been a major cause of desertion of steadings and abandonment of land (supra p. 165). A note of those farms absorbed by others over the period 1600-1750 may thus be adopted as a supplementary method of dating changes in land use.

Evidence exists for the amalgamation of eight pairs of farms of which two were almost certainly linked with the abandonment of about 30 ha of cultivation (Table 8.6). Five were amalgamated in 1720-50, although this may not reflect a regional trend owing to the small number of farms and records under discussion. It is clear, however, that some upland farms were amalgamated in the period 1600-1750, perhaps frequently in the early eighteenth century.

Amalgamation of tenancies A further cause of reversion of farmland may have been the reduction in number of farms with multiple tenancies, the decline in ratio of labour to land contributing to a fall in the arable acreage. Amalgamation of tenancies is noted to have occurred on at least four farms over 1600-1750, of which three occurred between 1714 and 1756 (Table 8.7).

Establishment of steadings Of 284 steadings omitted by Pont and Blaeu but mapped by the Military Survey, eleven were sited within the moorland core and may have been associated with primary reclamation at the margin of cultivation (Table 7.1). Evidence for their existence in the mid-seventeenth century was found for three of these sites and for a fourth, Newlands, which is likely to have been sited at the limit of cultivation and thus to have been linked with intake of new land (Table 8.8). The dates of reference to these farms indicate the establishment of three before 1670 and of four before 1702.

Table 8.6

Date of amalgamation of farms, 1600-1750

name	last date of reference	area (ha) of associated permanent abandonment of land	approx. location (GR)	reference
Easter Byre-cleugh + Handaeswood	1720-50	20	626577	Roxburghe, NRA(S) 1/41/6
Easter + Wester Byrecleugh	1730-50	10	628580	Roxburghe, NRA(S) 1/40/8/20
Lies (Langton-lees) + Welcleugh	pre-1627	7	733519	MacGrigor, 1835: 16-19
Townhead + Redcleugh	pre-1749	-	c.802694	RUL, Dunglass, EAS 1/2/23
Redheugh + Hazelton	1740-46	-	c.816705	RUL, Dunglass, EAS 1/2/30
Woodend + East Miln	pre-1742	-	c.793702	RUL, Dunglass, EAS 1/2/23
Innerwick + Braidwood	1723-54	-	725732	SRO, Biel, GD 6/1717/1 GD 6/1742
Templelands + Dryburnford	1723-54	-	718751	SRO, Biel, GD 6/1717/1 GD 6/1742
		TOTAL 37 ha		

note: those farms absorbed are underlined

Table 8.7

Amalgamation of tenancies, 1600-1750

name	no. of tenants	(date)	no. of tenants	(date)	location (GR)	reference
Tollis Hill	3	(1656)	1	(1750)	518579	Romanes and Curle, 1897-8
Penshiel	3	(1714)	1	(1756)	643633	SRO, Hay, GD 73/1/11 GD 73/4/292
Kingside	3	(1714)	1	(1756)	626645	SRO, Hay, GD 73/1/11 GD 73/4/292
Crowhill	3	(1723)	1	(1754)	736741	SRO, Biel, GD 6/1717/1 GD 6/1742

Conclusion It may be concluded that widespread abandonment of settlement, especially at high level, occurred largely over 1650-1750, much of it after 1690. This appears to have been, at least in part, a function of the amalgamation of farms and tenancies and seems to have been linked with the reversion of arable land. About 100 ha of associated former cultivation may be identified on aerial photographs.

There is little evidence of primary reclamation at the periphery of the moorland core, although some occurred before about 1670 on lower moors that had been by-passed in the early medieval period.

Table 8.8

Date of establishment of steadings, 1600-1750

name	date	location (GR)	reference
Newlands	1596-1671	569673	Yester (NLS) NRA(S) 0439: 1/4/5
Ramersyd (Rammerside	1596-1654	639717	SRO, Yester, GD 28/2/1711
Liehouss (Leehouse)	1596-1654	628711	SRO, Yester, GD 28/2/1711
Suynhope (Soonhope)	1596-1702	527542	SRO, Yester, GD 28/2/2263

Evidence from associated change in the rural economy

The consideration of evidence from other sectors of the rural economy assumes a causal relationship between intake or reversion of farmland and other indices of economic change; this has yet to be established. The causes of intake or reversion are reserved for discussion in Chapter 11 but it is convenient at this stage to note parallel trends in, for example, land values and cereal prices that may confirm or negate the chronology postulated from the study of estate plans, manuscripts and the change in steadings. Since no firm conclusions may be reached at this stage the following discussion is brief.

It is clear that the state of agriculture in the Borders was influenced by the degree of political stability. Thus the Reports of 1627 stated that 'this evaluation [of farms] we testifie to be of walow onlie in tyme of peace' (MacGrigor, 1835: 4); and MacFarland noted in 1649 that after the union of the crowns and the decrease of feuding the deterrent to improvements in agriculture and architecture had been removed and a 'spirit of building ... much abounded in these later times' (Mitchell, 1908: 171).

Prior to this, growth of population in the sixteenth century seems to have increased pressure on the land (Smout, 1969: 147); and the demand for more tillage is likely to have been further encouraged by the high price of oats and bere from 1630 to 1660 (Mitchison, 1965) which may have invoked greater response from a farming system in south-east Scotland that was becoming increasingly commercialised (Smout and Fenton, 1965; infra p.366).

The combination of these and other factors appears to have led to quite rapid rises in the value of arable land. Fenton (1963) has pointed to substantial increases in rents in East Lothian between 1600 and 1627 from evidence in the Reports on ... Certain Parishes and notes that the application of lime was one of the reasons behind them. Indeed, a study of the manuscripts of the estate of Yester confirms that the use of lime was widespread in the seventeenth century (supra p.218).

The increased value of land is likely, in turn, to have stimulated the demand for further improvements, particularly enclosure which led to further productivity of tillage (Smout and Fenton, 1965).

Yet rents were not rising on the highest and most remote farms. In the parish of Langton the Reports of 1627 recommended a reduction in rent for three farms and a moratorium on the rents of a further three (MacGrigor, 1835: 16-19). It is probably not a coincidence that of these six farms three were abandoned before 1750. Indeed the relative unprofitability of the uplands for tillage may have been the cause of 'clearances for sheep farming on the classic pattern' (Smout and Fenton, 1965).

After 1655 the combination of falling grain prices (Mitchison, 1965) and high rents seems to have led to the accumulation of arrears of rent, and both this and the slow expansion of an urban market at times glutted by cheap grain promoted a decline in demand for upland arable land (Smout and Fenton, 1965). The consequent consolidation of farms seems to have been encouraged by, first, the decline of feuding (and thus of the need to maintain a large number of dependants on an estate) and, secondly, the consecutive occurrence of poor summers in the 1690s (infra p.333).

A number of these factors will be discussed separately in later chapters but it is convenient to summarise the evidence presented so far. Both political and economic conditions seem to have favoured the improvement and extension of farmland in the first half of the seventeenth century. After 1660, however, the incentives for expansion may have declined and contraction of marginal arable land was wrought, in part, by the consolidation of upland farms.

THE IMPROVEMENT AND WAR-TIME AGRICULTURE: 1750-1815

The period 1750-1815 opens on the eve of a widespread acceptance of improvements to agriculture in south-east Scotland and encompasses the burst of activity heralded by rising prices in the Napoleonic Wars. It is convenient to draw its close in 1815, the year in which the collapse of livestock prices followed that of cereals, and after which agriculture was characterised by depressed conditions and reduced investments.

Qualitative change at the limit of cultivation

The adoption of improvements to agriculture in Scotland heralded fundamental changes to the character of the cultivation limit. The introduction of root crops, sown grasses and clover allowed the use of improved rotations which, with other innovations, replaced the infield-outfield system of farming with an increased intensity of cropping and a greater productivity of land. Thus tillage at the limit of cultivation, which originally had occurred perhaps three years in seven (Fenton, 1963), gave way to perennial use of land in a five- or seven-course rotation. These changes were reflected in a modification of the infrastructure of agriculture: there were often rapid changes to the size of farms, the level of rents, and the length and conditions of farm leases.

The progress of the agricultural improvements has been described by Fenton (1963) for East Lothian, by Dodgshon (1969) for Berwickshire and by Handley (1953 and 1963) for Scotland as a whole. They need not be reiterated here but, in so far as they were the catalysts of spatial change at the cultivation limit, they will be considered in Chapter 11.

It is important in the present context to recognise that, as a result of these improvements, qualitative changes in the use of land accompanied changes in the quantity and location of upland tillage.

Thus the date of adoption of the improvements provides a valuable clue to the timing of movement by the limit of cultivation. Several of these which are considered to have been fundamental to a change in farming systems in the eighteenth century have been selected and the dates of their widespread acceptance in the upland of the study area have been traced from both contemporary and secondary sources. A summary is presented in Table 8.9. It is clear that, while innovation of the improvements occurred in the lowlands in the mid-eighteenth century, they were not adopted in the Lammermuir Hills until the period 1780-1800. Indeed this period seems to have been one of remarkable change in the upland areas for almost all the elements of the improvements were adopted at this time.

Spatial change at the limit of cultivation

A summary of existing evidence

In the previous chapter it was concluded that at least 2,290 ha of moorland was reclaimed between 1750 and 1800, 5,215 ha over 1750-1825. The great proportion of this occurred on the Stow Uplands, Coldingham Moor and the Westruther platform. Over the period 1750-1800 230 ha of arable land were permanently abandoned, 470 ha over 1750-1825, the excess of intake over reversion apparently increasing in 1770-1800 but declining once more after 1800.

Table 8.9

Date of selected improvements to agriculture
in south-east Scotland

type of improvement	date of innovation on field scale	date of widespread acceptance in Lammermuir hills	sources
crops:			
potatoes	1726	1780-90	Fenton (1963); OSA: XIII: 386
turnips	1740	1770-90	Fenton (1963); Farmer's Mag. (1803)
clover	1740	1770-90	Fenton (1963); Farmer's Mag. (1803)
rye-grass	1720-30	1770-90	Fenton (1963); Farmer's Mag. (1803)
early oats	early 17th c.	1770-90	Mitchell (1908: 175); Farmer's Mag. (1803)
rotations:			
with fallow of infield	1600	1780-90	Fenton (1963); Handley (1963: 67)
with sown grasses	1720-30	1780-90	Fenton (1963); Farmer's Mag. (1811)
enclosure (on farm scale)	1720	1780-1800	infra p.343
implements:			
Small's plough	1764	1790-1800	supra pp.150-1
drills, harrows, rollers	1770-80	1800-1810	Farmer's Mag. (1811)
levelling and straightening of ridges	c.1690	1780-1800	supra p.152
liming	early 17th c.	1760-80	Fenton (1963); OSA: XII: 51-2
livestock:			
cheviot sheep	1790	1790-1800	OSA: XIII: 386; Naismyth (1796)

In the following section reference is made to published and to manuscript sources to check the foregoing conclusions and to refine the dating of trends of intake and reversion. Direct evidence from estate plans, published contemporary accounts, estate manuscripts and processes of divison of commonty is followed by a consideration of indirect evidence from changes to upland settlement. Trends in other sectors of the regional economy are examined only where the primary sources are inadequate.

The direct evidence for land-use change

Manuscript estate plans The coverage of estate plans increases rapidly with the spread of enclosure after about 1760, and it is possible to view movements of the moorland edge by reference to thirteen plans extant for the late eighteenth and early nineteenth centuries (Fig. 8.3).

It seems that between about 1750 and 1780 the abandonment of elevated arable land continued, though at a reduced rate. On the upper parts of the Whittingehame estate one steading disappeared entirely, one became derelict and a third contracted in size over 1759-93 (GR 616712; RHP 2515: Whittingham, 1759; RHP 2516: Whittingham, 1793). Abandonment of outfield seems to have continued at Blackcastle in Innerwick over much the same period (GR 710700, RHP 2514: Blackcastle, 1753; RHP 2519: Blackcastle, 1822-23). At Marchmont, however, it is possible to point specifically to the decade 1770-80 as a period of substantial retreat of cultivation. This is concluded after study of plans for 1765 and 1791, the latter of which is unfortunately missing but for which reproductions have been preserved by Maxton (1935). These indicate that, while the maximum extent of cultivation occurred shortly before 1765, about 90 ha of tillage north of Bedshiel had reverted some years before the survey in 1791 (GR 682519; Marchmont Ho.; Marchmont, 1765).

Yet there is evidence of reclamation over the period 1750-70. The farm of Riddel Lodge (Lauder) was established in the 1760s, although almost one-half of its arable had been put down to permanent grass by 1803 (GR 526568; RHP 1215/1: Riddel Lodge, 1808).

However, most of the advance occurred after 1780. At Whittingehame primary reclamation and enclosure was extensive between 1793 and 1819 (RHP 2518: Whittingham, 1819), and at Drygrange between 1780 and 1790 (GR 578355; RHP 6590: Drygrange, 1796). This period seems also to have been characterised by secondary reclamation of land initially abandoned after 1750, for at both Whittingehame and Blackcastle there occurred a re-advance onto reverted outfield.

Elsewhere the high levels of cultivation established by earlier advance were maintained. At Gamelshiel and Cockburn, where tillage had been established well before the improvement, cultivation continued at 395 m and 230 m O.D.

The product of these trends was that the limit of improved land reached its highest point for perhaps 200 years in many parts of the study area; for after 1812 there are signs of retreating arable in a number of areas (GR 623714; RHP 8744: Duchrie, 1811; GR 767587; RHP 2587: Cockburn, 1812; GR 518579; RHP 1258: Tullis Hill, 1820). Indeed, it seems that at some sites cultivation was retreating from about 1800 onwards. At Weatherly (Innerwick), the 'cornland' on a plan of 1792 may be correlated on aerial photographs with superimposed improved and pre-improvement cultivation ridges lying now in permanent moor (GR 678718, RHP 1037: Waldalie, 1792). The implication is that, since the old ridges are barely altered, tillage at this site cannot have continued long after 1792.

The suggestion is, then, that while intake occurred at lower levels over 1750-80, reversion at high levels was common and may have been especially frequent in the 1770s. After 1780 reclamation proceeded apace, particularly on the lower moors, and over 1800-12 the limits of improved land achieved their furthest extent.

Contemporary published accounts With the recovery of prices in the 1750s but particularly from 1762 (infra p.369), interest in extending the area of arable increased; and following, first, the introduction of crops more tolerant of an upland soil and climate and, secondly, the easier availability of lime, attention was increasingly turned to the improvement of moorland. The Lammermuir Hills were seen in a different light to what they had been twenty years earlier.

> I present to the view of my reader an immense moor between Greenlaw in Berwickshire, and Fala in Mid Lothian, as a desirable subject for an improving farmer, now that there is access to lime by a turnpike-road. (Kames, 1776: 67)

Yet there is surprisingly little evidence that Kames' offer was accepted. Andrew Wight's reports (1778) for the commissioners of the annexed estates make no mention of reclamation in the uplands of south-east Scotland. Indeed it is not until the reports of the Statistical Account and the Board of Agriculture in the 1790s that firm evidence of advancing cultivation is available. By this time the limits of improved land were reckoned to be advancing in eight of the 29 parishes in the study area:

Channelkirk	(OSA: XIII: 391)
Cockburnspath	(OSA: XIII: 223)
Coldingham	(OSA: XII : 44)
Cranshaws	(OSA: VI : 438-9)
Humbie	(OSA: VI : 157)
Legerwood	(OSA: XVI : 485)
Melrose	(OSA: IX : 78)
Stow	(OSA: VI : 135)

In some areas, such as Humbie, Longformacus (OSA: I: 70) and Whittingehame (OSA: II: 346, 355) the new land was cropped only occasionally and was put down to pasture. But the lighter soils were often regularly cropped after a heavy dressing of lime. In Cranshaws it was reported in 1792 that 'Very considerable crops of oats, barley and pease have by means thereof been raised from land which in its natural state was of little or no value' (OSA: VI: 438-39). In the Stow Uplands the advance of tillage was pronounced and in the parish of Melrose the output of grain was reckoned to have doubled between 1760 and 1790 owing to the extension of arable (OSA: IX: 78).

However, where cultivation had advanced far in the medieval period, losses between 1400 and 1770 were not made up by the gains of the 1780s. In north Greenlaw it was noted that at the farms of Bedshiel, Hurdlaw and Haliburton:

> 'Several parts ... are dry and arable but have not been in tillage for at least 100 years past. These, in their present state, are worth very little: Were they taken up and well limed, and, after a crop or two of oats, sown with white clover seed, their value would be considerably increased.
> (OSA: XIV: 513)

Even in 1803, which followed three years after a peak of grain prices, contemporary writers were awed by the quantity of former cultivation (Farmer's Magazine, 1803: 508).

The reporters of the Board of Agriculture (Hepburn, 1794: 15) concluded that a great deal of the moorland periphery had been brought under cultivation in 1760-90 but 'it is not till very lately that attempts have been made to carry that into the interior parts' (Lowe, 1794: 96); and where higher lands had been reclaimed they were mainly put down to turnips or clover for sheep (Hepburn, 1794: 104). However, Lowe noted that

> Although, in general, corn-husbandry is not by any means the ultimate view of the greatest part of the farmers in Lammermoor, yet it is sometimes an object of attention, and highly advantageous, both as a present emolument, and accessary in its consequences, for promoting his ultimate views; the improvement of live-stock, melioration of his wool, etc.
> (Lowe, 1794: 100)

Since the major incentive to reclamation was thus the high price of grain which offered a quick, often large, return it was common in the 1790s for upland farmers to plough up old pasture land which had a sufficient depth of soil. The new arable was generally limed and dunged during a summer fallow, and barley and oats would follow a drilled crop of turnips. The land might then be laid down to clover and rye-grass for hay (Naismyth, 1796: 66).

While the cost of labour and lime tended at first to restrict the areas of extensive intake to the periphery of the moors owing to the inadequacy of roads into the upland interior (Kerr, 1809: 343), it seems that the second leap in grain prices after 1803 (infra p.370) and improving access in the Lammermuirs encouraged intake even of the remote haughs and south-facing slopes (Kerr, 1809: 343).

<u>Estate manuscripts</u> Owing to the nature of early published accounts, it is unwise to base conclusions on their evidence alone. For this reason, reference is made to manuscript sources.

A valuable source for the study of agricultural change during the Napoleonic Wars is the report by David Low (later Professor of Agriculture at the University of Edinburgh), on the estate of Marchmont in 1819 (GD 158/20). Low noted that the great proportion of intake occurred after 1800 when the fiars price of oats at Haddington reached £2 8s 11d per Imperial Quarter. At Marchmont there were substantial increases in arable on the farms of Greenlawdean, Haliburton, Catmoss and Channabank (GD 158/20: 49, 59, 69, 76).

Recoup of the heavy outlay in lime and labour depended, however, on the maintenance of high prices and on good seasons, and continual cropping of the new land was required to take advantage of both (Cranshaws, OSA: VI: 439). Hence the fall of prices and the succession of unfavourable summers after 1815 combined with declining yields from exhausted soils to promote a rapid reversion of tillage to moor at the close of the war (GD 158/20: 59, 61). This reversion seems to have occurred largely in the years 1817-19 and was the product of very deficient harvests in 1816 and 1817, which had led to the purchase of grain at high prices from lower farms (GD 158/20: 9, 44, 61). Indeed the fall in grain prices in 1812 seems to have been less significant than smaller falls in 1814 and 1815 for the arable area continued to increase on some farms up to 1819: the farmer at Haliburton was bankrupt by over-extension of his cultivation in 1813-16 (GD 158/20: 57).

A similar expansion in arable was evidently in progress throughout south-east Scotland. Dodgshon (1969: 296) has found a reference to an application by the tenant of Byrecleugh (Longformacus) in 1796 to open up some of his pasture ground, a request at which the surveyor of the Roxburghe estate expressed some amazement. There is also an indication of an increase in arable in the Cheviots between 1795 and 1807 (Dodgshon, 1969: 297). But the suggestion is that an expansion of arable was less pronounced elsewhere in Scotland, for while it was recorded in the Statistical Account for eight of the 29 parishes in the study area, Morgan (1969: 21) found a similar record for only 105 parishes out of a total of 893 in Scotland. The explanation for this is likely to be found in the gentle morphology and dry climate of the Lammermuir Hills.

Divisions of commonty Both the location and date of reclamation in the eastern Lammermuirs are in part the product of divisions of commonty which released land for cultivation in four areas: Coldingham in 1776, Innerwick and Blackcastle in 1783, Duns in 1786 and Chirnside in 1805. The distribution of these commonties and the explanation of changes in the moorland edge provided by their divisions are discussed in Chapter 11. Consideration is given at this point only to their use as indicators of dates of reclamation.

A study of aerial photographs and county maps has indicated that there was extensive reclamation at Coldingham between 1776 and 1800 (supra p. 185). Evidently much land was taken in soon after the division of the common for a report written in 1791 noted that 'considerable improvements by enclosing, draining and liming have been made thereon by several of the heritors' (OSA: XII: 44). Indeed in 1778, only two years after division, Wight (1778: 532-5) found large areas of the moor already reclaimed.

At Innerwick the dates of reclamation are less easily defined. On Blackcastle Hill (GR 710715) and Needle Hill (GR 702712) a total of 130 ha was taken in sometime after division but was abandoned before 1850. Of this, about 85 ha was reclaimed for a second time in the 1880s, leaving the remainder as faint traces of improved cultivation ridges in moorland. The initial intake of a small part of Blackcastle Hill was delayed until 1880. This much may be interpreted from Ordnance Survey maps and the relict landscape. It is not possible to trace the changes in moorland more precisely, although it seems likely that most of the initial intake occurred during the period of high prices, that is, up to 1812-15, and the reversion occurred in the post-war depression.

At Duns there was a rapid reorganisation of farms between 1786 and 1797 which resulted, first, in the disappearance of five steadings, probably associated with the abandonment of about 70 ha of arable and, secondly, in the reclamation of 170 ha and the establishment of two new farms at Knock and Commonside on the northern periphery of the former commonty (SRO, CS21 23/6/86).

A perambulation of 1763 reported large encroachments by the tenants of Quixwood and Channobank on the south side of Chirnside common (Craw, 1922: 440-41). A study of aerial photographs suggests that the illegal tillage covered about 63 ha. About 30 per cent of it was reclaimed for a short time after division in 1807 but reverted to moor before 1860, leaving a superimposed pattern of improved and unimproved cultivation ridges. New farms of Paitshill (GR 747669) and Whiteburn (GR 671643) were established on two allotments of the divided common, the first before 1826 for it is recorded on the map of Sharp, Greenwood and Fowler, and the second in 1826-54 for it first appears on the earliest Ordnance Survey maps. The reclamation associated with these new farms seems to have taken place throughout the period 1807-54.

Finally, a comparison of plans for 1765 and 1821 at Marchmont House indicates a substantial intake of Dogden Moss by the farms Haliburton and Moss-end, and of Greenlaw Moor by Greenlawdean and Whiteside (GR 705468; Marchmont Ho.: Marchmont, 1765; 1821). The report of 1819 records that all of this was carried out after 1801, most of it after 1811. At Whiteside 60-70 acres (24-28 ha) of the reclamation occurred over 1813-19 at a cost exceeding £600. Low noted that:

> Since the period of this outlay, times have been so unfavourable that but a small proportion of it will ever be recovered.
>
> (GD 158/20: 59, 49, 82)

Conclusion A study of direct evidence for the date of movement by the limit of cultivation suggests the following conclusions:

1. Between 1760 and 1780 the primary intake of moorland increased, especially in less remote areas, but reversion continued and may have been widespread in the 1770s on the highest and most remote farms.

2. From 1780 reclamation of the lower moors proceeded apace, but major inroads on the uplands did not occur until after 1790 and were probably not common until 1800.

3. The main phase of reclamation at high level occurred over 1800-16. It seems to have continued beyond the collapse of grain prices in 1813.

4. In a number of areas the Napoleonic advance failed to reach the limits achieved in the medieval period.

5. The distribution and date of intake in the eastern Lammermuirs is partly the product of divisions of commonty.

The indirect evidence for land-use change

Amalgamation of farms

While evidence from estate plans and estate manuscripts allows the precise dating of reclamation, it is necessary to study changes in the pattern of settlement to establish an adequate chronology of land abandonment. This may be achieved by reference to series of rentals which illustrate the trend of farm amalgamation on three estates in the study area: Innerwick and Thornton (SRO, Biel Muniments, GD 6), Dunglass (RUL, Dunglass Estate MSS, EAS 1/6) and Marchmont (SRO, Marchmont Estate MSS, GD 158).

At Innerwick and Thornton eight pairs of farms were amalgamated over the 100 years following 1720, the majority in the period 1776-1820 and three between 1776 and 1792 (Table 8.10). The implication is one of increasing amalgamation toward the end of the eighteenth century, although the sample is too small for this to be certain.

At Dunglass, however, a distinct phase of amalgamation is discernible over 1770-80. Of 16 farms amalgamated between about 1740 and 1820, nine were amalgamated in 1770-90, five of them in 1778 alone (Table 8.11). Indeed this year seems to have been one of major change on the estate, characterised by additional alterations to farm boundaries and the permanent abandonment of at least 8 ha of tillage (RUL, EAS 1/6/1).

Table 8.10

Dates of amalgamation of farms on the estate of Innerwick and Thornton, 1694-1832

name	date	location (GR) of absorbed farm	reference (GD 6)
Innerwick + <u>Braidwood</u>	1723-54	725732	1717/1, 1742
Templelands + <u>Dryburnford</u>	1723-54	718751	1717/1, 1742
Thorntonloch + <u>Whitehill</u>	1754-76	742728	1742, 1755
Skateraw + <u>Knowehead</u>	1776-92	735755	1755, 1762
Crawhill + <u>Innerwick</u>	1776-92	725738	1755, 1762
Thorntonmill + <u>Gateside</u>	1776-92	744745	1755, 1762
Crawhill + <u>Thorntonmill</u>	1792-1820	745742(?)	1762, 1769/1
Thorntonloch + <u>Thornton Tower</u>	1792-1820	736735	1762, 1769/1

note: absorbed farms are <u>underlined</u>

source: SRO, Biel Muniments, GD 6

Table 8.11

Date of amalgamation of farms
on the estate of Dunglass, 1743-1839

name	date	location (GR) of absorbed farm	area (ha) of associated permanent abandonment of land	reference (RUL, Dunglass)
COCKBURNSPATH BARONY:				
Linhead + Sneep	1752-70	783704	-	EAS 1/2/24 1/6/1
Chapelhill + Bishop's Green	1770-78	c.777717	-	EAS 1/6/1
Chapelhill + ½ Wheatacres Chesterfield + ½ Wheatacres	1778	c.780700	-	EAS 1/6/1
Linhead + Peasmill	1778-85	793704	-	EAS 1/6/1 1/2/25
Chapelhill + Chesterfield	1800-21	781697	-	EAS 1/2/25 1/2/27
AULDCAMBUS BARONY:				
Redheugh + Hazelton	pre-1742	c.816705	-	EAS 1/2/23
Woodend + East Miln	pre-1742	c.793702	-	EAS 1/2/23
Townhead + Redcleugh	pre-1742	c.802694	-	EAS 1/2/23

Table 8.11 (contd)

name	date	location	area (ha)	reference
Auldcambus Townhead + Townhead	pre-1743	802694	9	EAS 1/2/28
? + Piperton	1752-70	c.815695	-	EAS 1/6/1
Fallabank + Headchesters	1752-70	817694	2	EAS 1/6/1
Auldcambus East Mains + Fallabank	1778	825695	-	EAS 1/6/1
Redheugh + Windylaws	1778-c.1790	832698	-	EAS 1/2/25
DOWLAW BARONY:				
Windylaws + Cauldside	1778	c.832698	-	EAS 1/6/1
Dowlaw + Farhill + Blaeuside	1778	c.852705	8	EAS 1/6/1
		TOTAL	19 ha	

note: absorbed farms are underlined

sources: RUL Dunglass Estate MSS

There is firm evidence of a similar trend at Marchmont. Of 22 farms which disappeared between 1764 and 1819, ten were amalgamated over the thirteen years 1778-1800, and four in the year 1778 alone (Table 8.12). Between one-quarter and one-third of the tillage abandoned as a result of this amalgamation was lost between 1778 and 1800.

Descriptive accounts of the region at the end of the eighteenth century suggest that the trends operating on these three estates were common to much of the study area. Eleven parishes reported in the Statistical Account an increase in size of farms over the second half of the century. In two parishes the number of independent farms fell by more than two-thirds (OSA: IV: 250; VI: 158-9), and in addition there was the removal of cottars' steadings, which may have contributed to the reversion of small patches of tillage on marginal land (OSA: I: 345; II: 358). A similar record of farm amalgamation is contained in the reports to the Board of Agriculture (Lowe, 1794: 13; Kerr, 1809: 117; Somerville, 1805: 51).

A major reason for the spate of amalgamation in the 1770s appears to have been the falls in price of grain which followed shortly after a rise in farm rents. The consequent increase in arrears of rent led to more frequent bankruptcy among tenants, their farms often being let to neighbours and later formally incorporated in the rental of the adjacent farm. Four tenants on the Marchmont estate became insolvent over 1772-1802 (GD 158, 1819).

Additional incentives for increase in size of farms included economies of scale in management costs (Kerr, 1809: 117), and the ability of

Table 8.12

Date of amalgamation of farms
on the estate of Marchmont, 1764-1819

name	date	location (GR) of absorbed farm	area (ha) of associated abandonment of land	reference (Low, 1819: page no.)
1. WEST SIDE:				
Greenlawdean + Broomhill	1764	705464	-	47-8
Greenlawdean + Snawburn	1794	701486	8	48
Greenlaw Mill + Greenside	1794	714455	-	53
2. NORTH SIDE:				
Mossend + S. part of Fangherst	1778	700498	1	57
Whiteknows + N. part of Fangherst	1778	700498	1	63
South Crofts of Bedshiel + mid-part of Fangherst	1778	700498	1	63
Bedshiel Mains + Weetfoot	1780	682518	21	62
Haliburton + part of Whiteknows	1792	693520(?)	10	56
Haliburton + Mossend	1801	696492	20	56
Bedshiel Mains + South Crofts of Bedshiel + part of Whiteknows	1806	685512	24	63

Table 8.12 (contd)

name	date	location	area (ha) of	reference
Haliburton + Hurdlaw	1811	663507	4	57
(Haliburton + Bedshiel Mains: recommended only	1819	684512	-	65)
3. SOUTH AND EAST SIDE:				
Bents + Kyleshill	pre-1778	729499	-	30
Castlemill + Henlaws + Catmoss	1778	713412	-	78
Whiteside + Flourishwells	1778	724483	-	82
Humehall + Oxmuir	1778	727418	-	?
Falsidehill + Meadowside	1779	c.683412	-	?
Kirklands + Stenmoor	1782	c.683402	-	?
Tenandry + Slegden Mill	pre-1787	712462	-	66
Eastfield + part of Tenandry	1787	718463	-	66
Humehall + Bellishill	1801	c.710414	-	?
Rowieston + Tofts	1802	745455	-	67
Polwarth Rhodes Habsfauld	1805	752504	-	28
Todrig + Foulshotlaw	1814	709441	-	44
		TOTAL	90 ha	

note: absorbed farms are underlined source: SRO, GD 158/20 larger farms to bear proportionally heavier rents and for their tenants to make greater improvements to the land (Lowe, 1794: 13).

It is clear from this discussion that amalgamation was particularly common in the late 1770s and was probably associated with the reversion of tillage, both temporary and permanent, at a number of sites. This confirms the conclusions arrived at from the study of estate plans and suggests that an upward advance of the moorland edge was delayed at least until the mid-1780s.

POST-WAR CONSOLIDATION AND RE-ADVANCE: 1815-60

It has been noted that an upward advance of tillage continued after the fall of the prices of both grain in 1813 and livestock in 1815. In the following section an attempt is made to pinpoint the cessation of this advance, to assess the impact of the post-war depression on limits of cultivation and to date the re-advance of cultivation in the mid-nineteenth century.

The direct evidence for land-use change

Manuscript estate plans

The coverage of plans for the study area becomes increasingly comprehensive after 1800 (Fig. 8.3). Twenty-three plans produced between 1815 and 1860 contain information on contemporary upland agriculture and their analysis contributes substantially to the establishment of a chronology of locational change of the cultivation limit.

Incentives for the expansion of upland arable land evidently continued at a level which promoted reclamation some years after the close of the Napoleonic Wars. In upper Lauderdale more than 35 ha, which had reverted to moor perhaps a century before, were under the plough in 1818 (RHP 1258: Tullis Hill, 1820). At an elevation approaching 360 m O.D., this reclamation is likely to have been unrealistic even if the fine summers and high prices had continued; as it was, the run of poor seasons and fall in prices induced rapid abandonment. Such abandonment may not have occurred before 1822 for there are signs of continued cultivation at a high level up to this time (RHP 2518: Whittingham, 1819; RHP 2519: Blackcastle, 1822-3). It was, however, widespread by the mid-1820s and was particularly common at high, exposed sites marginal to the cultivation of cereals (RHP 2587, 1760: Cockburn, 1812 and 1825; RHP 10013: Gammelshiels, 1830; GR 866636; RHP 9304: Hillend, 1831). In areas where arable had been put down to grass in the 1770s, the trend was to rough pasture (Marchmont Ho.: Marchmont, 1821; RHP 1215/1: Riddel Lodge, 1808).

Evidently reversion was less extensive on lower farms and was soon balanced by renewed intake of moor. Reclamation over the period 1835-60 increased the proportion of arable by up to one-third on farms in three sectors of the study area: the Stow Uplands (GR 513414; NLS, EMS.s.333: Colmsleehill, 1838; GR 564398; RHP 1206: Carolside, 1826) the Coldingham outlier (GR 822654; RHP 4096: Renton, 1811) and the mosses of the Gordon and Westruther platforms (GR 647454; NLS, EMS.b.4.1.XIII: Fawside, 1836; GR 679436; NLS, EMS.b.4.1.XI: Middlethird, 1836).

In contrast to this was the continued abandonment of long-established cultivation in the central Lammermuirs. At Gamelshiel, once a grange of

Kelso Abbey, about 19 ha of tillage reverted to permanent moor over 1830-53. The arable land of more recent high-level intakes reverted over a similar period at Riddel Lodge and Deuchrie (RHP 8752: Duchrie, 1853).

Thus the trend was one of continued rationalisation of the limit of cultivation - of retreat at elevation and advance on the lower moors - a pattern that is repeated throughout the period from the late medieval era up to the early nineteenth century. Scattered through this chronology are variations to the pace and direction of change one of which, in the post-Napoleonic era, is evidently characterised by a check to reclamation and an increase in reversion from about 1822-35. After this point intake is renewed at lower levels but is no longer widespread above 300 m. O.D.

<u>Contemporary published accounts</u>

There is some contradiction, however, between the manuscript sources and the evidence submitted by the local witnesses to official enquiries into the state of agriculture in the post-war years. Robert Hope of Fenton Barns (Dirleton) reported to the Board of Agriculture (1816: 117-120) that four large farms in his district were unoccupied and that several tenants had offered to give up their farms but had been held to their leases. At the same time Robert Brown of Markle (Prestonkirk) estimated that three-quarters of the farmers in East Lothian were living on their capital and that improvements to agriculture had all but ceased (Board of Agriculture, 1816: 106-7).

Whether or not these reports were exaggerated, the influence of the depression on marginal cultivation was less immediate than might be supposed. Witnesses before the Select Committee of 1821 tended to contradict one another as to the quantity of inferior arable land that had fallen out of use since 1815. Probably closest to the truth was the evidence of John Brodie of Scroughall who noted that the reversion of marginal land ploughed in the war was not yet widespread but was likely to become so if prices remained at their present level (Select Committee, 1821: 323). He estimated that the price of oats required to keep these areas under cultivation was 30s to 32s a quarter. The fiars price of oats at Haddington first fell below this figure in 1819 (Fig. 11.4), and it is reasonable to assume that reversion of upland arable began about this time, becoming more widespread in 1822 when, for the first time in two decades, prices fell below 20s a quarter. By this time the combined effect of low prices, high rents and poor seasons (in 1816 and 1817) had eaten into profits of the previous twenty years, so that Robert Hope commented of his neighbours

> from being generally in comfortable circumstances [in 1816], the great majority of them were soon reduced to little better than a state of bankruptcy, with the high money rents that they had contracted
> (Minutes of Evidence, Select Committee, 1836: Q.9932)

It was estimated that by 1823 the profits of tenant farmers in East Lothian had been reduced to 14 per cent of those averaged during the war years (Scott, 1823).

It is clear, however, that the fall in prices brought varied reactions from different parts of the study area. The reports of the New Statistical Account (1845), written over 1834-36, record a contraction of tillage in three of the highest parishes in the Lammermuirs (NSA: II, Berws: 78, 95, 101-2). The return for Cranshaws noted that

> More had been cultivated at one period, but was allowed to return to its original state, with the exception of a few patches, which are turned over occasionally, to renew the pasture. It is very doubtful whether the farmer would gain by keeping much more land under the plough, while the market prices are so low, all the roads in such a neglected state, and the distances to place of sale so great.
> (NSA: II, Berws: 101-2)

Yet, even where tillage was abandoned and heather was 'fast covering several places where good grain was wont to grow', improvements such as tile drainage and enclosure had advanced rapidly in the 1820s (NSA: II, Berws: 78). The intake of moor was reported to have continued unchecked in four less remote parishes (NSA: II, East Lothian: 162-3; II, Berws: 121, 308), among them the parish of Spott where

> A considerable extent of waste meadow or muirland has been reclaimed, and brought under the plough, on the north base of the Lammermuirs.
> (NSA: II, East Lothian: 230)

Moreover, by frequent liming and the introduction of bone-meal and tile draining, increases in productivity often balanced losses due to the contraction of tillage (NSA: II, East Lothian: 58; II, Berws: 9, 36).

It seems, therefore, that the 'alarming state of distress' of Scottish agriculture noted by Sinclair (1823: 35) was both short-lived and over-generalised. The permanent effects of it were seen in the abandonment of only the most marginal arable land and the most remote farms, and this was largely restricted to the five years from 1819-23. Further depression after 1823 was avoided by the reduction of rents by about one-quarter, by the conversion to corn rents and by economising on inessential investments on the farm (Low, 1823; Greg, 1842; Cleghorn, 1823).

While the early 1820s saw the acceleration of retreat from the higher farmland, the 1840s and 1850s heralded a renewed advance onto the Stow Uplands and the lower moors. This followed the general acceptance of tile drainage by the mid-1840s and the introduction to the region of Peruvian guano in about 1841 (Sanderson, 1863). More precisely, the beginnings of widespread reclamation can be dated from 1846 when, first, the opening of the North British Railway gave ready access to artificial manures and, secondly, large loans for drainage were made available by the government (Skirving, 1873).

The consequences were far-reaching. Sanderson estimated that over 1848-72 50,000 acres (20,235 ha) of 'pastoral upland' had been added to the arable areas of Berwickshire and Roxburghshire. Most of this intake probably occurred in the late 1850s for reclamation was given a fillip, first, in 1852 by higher prices and a good harvest, and again from 1853 by high prices during the Crimean War. Indeed, Gibb (1921) notes that the greatest advance occurred after 1858, which accounts for the relatively small amount of upland intake evident on the first Ordnance Survey maps of the study area (1852-60). This is confirmed by the distribution of land reclaimed between the first and second editions of the Ordnance Survey sheets, which corresponds closely to the locations of intake mentioned by contemporary observers (Fig. 3.2).

The newly reclaimed land was often cultivated on a five-year rotation of turnips, barley, two years of grass and a fifth of oats (Sanderson, 1863). Since the intakes were regularly under the plough, they thus represent an advance of the limit of the cultivation: not until the 1870s did longer leys of grass replace cereal crops in the rotation, altering the nature of the moorland edge from one of a limit of cropping to a limit of improved land, a division less readily defined.

The conclusion is, then, that reversion of high-lying arable land, some of it initially reclaimed during the Napoleonic Wars, occurred over the years 1819-23. At the same time there was a check to the extension, but not to the intensity, of tillage on lower farms. From the mid-1830s both primary and secondary intake of lower moor proceeded steadily up to the acceleration of advance from 1853. Since most of this advance occurred too late to be recorded on the first edition of the Ordnance Survey sheets of the study area, discussion of it is reserved for the following section.

Estate manuscripts

The fall of stock prices in 1816 and the failure of crops in 1816 and 1817 caused upland farmers to sustain heavier losses than farmers on lower land (GD 158/20: 61). By 1819 it seems that much of the capital of the stock farmers had been exhausted. Yet Low reckoned that at least three farms on the upper part of the Marchmont estate continued in 1819 to be over-cultivated (GD 158/20: 48, 59, 112); and at two farms reclamation continued after 1813, one being taken in hand from the bankrupt tenant in 1819, the other recouping only a small part of its investment in 60 acres of new ground (GD 158/20: 57, 82). The implication is that by 1816 reclamation on hill farms had ceased and that by 1819 the inferior land was being allowed to revert to moor.

Divisions of commonty

This trend is mirrored by changes in land use on the commonties of the eastern Lammermuirs. There is a record in 1812 of tillage encroaching on the north side of Dunbar common, but being abandoned before 1816. The site may be located by reference to relict plough ridges on aerial photographs (GR 633717; GD 73/4/134: 28).

At both Innerwick and Chirnside, where extensive intake of moorland had followed divisions of the commonties in 1783 and 1805, much of the new arable fell down to rough pasture before 1853-55.

Evidently the release of land for cultivation after the division of Oldhamstocks Common in 1836 encouraged the primary reclamation of about 70 ha of moor and the secondary intake of former encroachments (GR 727697; RHP 536/2-3: Oldhamstocks, 1834) but at Dunbar, which was divided in 1833, reclamation was delayed until after 1853.

The indirect evidence for land-use change

Evidence from associated change in the rural economy

The hypothesis of an intense but short period of hardship for marginal farms over 1819-23 is supported by evidence for both changes in and for arrears of rents.

For the estate of Marchmont the total rental, which had more than doubled between 1791 and 1813, depreciated in value by 20-25 per cent over 1813-19, at which time Low recommended for four farms the reduction of excessive rents that had been contracted in the war years (GD 158/20: 10, 62, 75, 77, 82). In 1822 an abatement of rent was offered to 22 tenants on the estate, reducing a total of £2,797 in arrears to £1,842 (RUL, Berw. 1/1/1:21-23).

At Dunglass arrears in rent, which had not disappeared in the war years but which had accumulated rapidly from 1815 to 1823, had begun to fall by 1834. Although reductions in rent had evidently contributed to this, several farms with unchanged rentals exhibited declining arrears (RUL, EAS 1/2/25, 27). The implication is that by the early 1830s increased returns from farming in marginal areas were beginning to offset costs of production, and it is unlikely that the area of tillage would have contracted further when farming was once more showing a profit.

Conclusion

From this analysis the following conclusions emerge:

1. Reclamation continued both at high and low levels up to the fall in stock prices and the first of two adverse seasons in 1816.

2. Over 1819-23 reclamation ceased in most areas and reversion of marginal arable was frequent in the uplands of the study area.

3. From 1823-35 improvements were renewed on lower farms, with some advance of tillage. Abandonment of high land continued at a reduced pace.

4. After 1835 there was steady intake on the eastern hills, Stow Uplands and the Upper Merse. The reversion of arable land probably ceased.

5. From about 1852 the rate of advance, both on the lower moors and on the foothills of the Lammermuirs, increased rapidly.

CONTINUING TRENDS: 1860-1900

The first, second and third editions of Ordnance Survey six-inch maps point to the extensive reclamation of moorland in south-east Scotland over 1860-1900. The distribution of this advance is illustrated in Figures 3.2 and 3.3. An examination of other evidence has revealed, however, that much of it was a secondary intake of farmland that had reverted to rough pasture either in the mid-eighteenth century or during the post-Napoleonic depression (Fig. 12.2). This was concentrated in the eastern Lammermuirs and on Coldingham Moor and occurred also as a narrow strip at the foot of the northern escarpment. Primary reclamation was centred on the Westruther and Gordon platforms and on the Stow Uplands.

The chronology of this advance may be traced from parish summaries of agricultural returns which are available for south-east Scotland from 1866. District summaries of East Lothian are extant for returns collected in 1853 but are unsatisfactory for a study of change in upland parishes alone.

Aggregates of the returns for 24 parishes at five-year intervals over 1866-1900 are illustrated in Figure 8.5. Changes to the boundaries of parishes in 1891 made necessary the exclusion of Fala and Soutra, Crichton and Stow from these totals (Sheenan, 1892). In spite of this, however, the remaining summaries are not a true record of the farmed area in the 24 parishes for they include acreages for farms which straddle the boundary of the study area (Coppock, 1960). The pattern of holdings in the region (Fig. 11.2) suggests that the resultant error is small in relation to the acreage under review, but it should be borne in mind that the data provide only a synoptic record of a regional trend. Moreover it should be emphasised that substantial variations in the data may have been the result of increases in accuracy of collection of the returns, and that apparent changes in land use should consequently be treated with caution.

This may be the case in the apparent increase of improved land. The returns suggest that the extension of improved land continued steadily from 1860 to 1875, after which it accelerated to a peak in the early 1880s. In the 14 years, 1866-80, the recorded area under crops and grass increased by 38,000 acres (15,380 ha) or by 13 per cent of the total area (Fig. 8.5). Thereafter it fell by 14,000 acres (5,670 ha) to 1885, and by about 4,000 acres every five years to 1900. The proportion of the region under crops and grass fell by 8.3 per cent over 1880-1900. It will be noted later that these trends are confirmed by other sources.

The length of leys adopted by Scottish farmers in the nineteenth century was often incompatible with a distinction between rotation and permanent grass required in the agricultural returns. Consequently there tended to be, on the parish level, quite large fluctuations from year to year between the two categories. With this reservation in mind, however, it is possible to assess changes in the proportion of land under tillage or in short and long leys that accompanied the intake and abandonment of moor.

After 1865 most of the reclaimed land was worked in rotations that included a longer ley of grass. In the returns to the Board of Trade there was an increasing tendency for this acreage to be registered as permanent grass, which consequently increased its proportion of improved land in the study area from 16.1 to 37.8 per cent by 1880 (Fig. 8.5). Since the area of tillage remained largely unaltered up to the early 1880s and there were only small increases in temporary grass, the expansion of improved land was almost entirely an expansion of permanent grass.

The period of most rapid advance occurred in the twenty years between 1858-77 when the cost of lime, tile drains and labour was low relative to the prices fetched by grain and stock (Gibb, 1921; Wilson, 1902). Frequently the new land was sought on gently sloping foothills of the southern and eastern Lammermuirs which did not require tile drainage (Gibb, 1921). Elsewhere cultivation moved onto heavier soils which were limed and drained, the tiles being laid in the furrows of earlier drainage systems if the land had been broken up during the Napoleonic Wars (Gibb, 1921).

The prize essays submitted to the Highland and Agricultural Society indicate the extent to which reclamation increased the proportion of improved land on some of the large foothill farms (Sanderson, 1863; Skirving, 1873). On those of Ellemford (Cranshaws), Blythe (Lauder) and Boon (Legerwood) the outlay on lime and drainage in the 1860s was more than double the annual rent. The optimism of the period was reflected by Sanderson (1863: 371)

> On the eastern base of the Lammermuirs there are hundreds of acres of pastoral land, which, from being dry and free of stones, is of easy tillage, has a fine exposure, and could be profitably reclaimed.

By 1875, following the fall of wheat prices and a poor season in 1872, the incentive for reclamation weakened. From 1879 many farms in Berwickshire were beginning to show a regular loss, compounded in 1879 by an extremely severe winter. In his evidence to the Royal Commission on Agriculture one Berwickshire farmer reckoned that 'if we have another bad season the whole farming district will collapse' (Richmond Commission, 1881: 516). Less likely to have overstated the case was the assistant commissioner reporting on southern Scotland. He estimated that the average tenant had lost capital equivalent to one year's rent (Richmond Commission, 1881: 528).

The agricultural returns suggest that over 1880-85 about 5 per cent of the study area reverted from improved land to moor, much of it land that had been taken in during the previous decade. Thereafter the acreage of crops and grass was recorded as declining by almost 2 per cent every five years up to 1900 (Fig. 8.5). Since most of this comprised the reversion of long ley to rough pasture, the proportion of improved land classified as permanent grass fell from 37.8 to 29.5 per cent over 1880-1900 (Fig. 8.5), though it is worth noting that such changes may have been the product of adjustment in definition.

Indeed, abandonment to moor seems to have occurred only on the most marginal land in remote areas, for evidence presented before the Royal Commission in 1894 claimed that little land had been left to waste, little even to permanent grass. Farmers chose rather to employ what was termed a wider shift, using longer leys and saving on labour and manure (Royal Commission on Agriculture, 1894: Q.26, 267, 22, 844).

Thus the returns indicate that 4,600 acres (1,860 ha), or 6.5 per cent, of tillage in the study area was put down to rotation grass over 1880-85 (Fig. 8.5), the latter increasing in area in the early years of the depression, but contracting from 1890, probably as leys were lengthened and were classified as permanent grass.

The periods of greatest difficulty appear to have been the years 1879-82, 1885-87 and 1893-95, and were generally attributed to poor seasons, low prices and the depression in trade, aggravated by the high rents contracted before 1880 (Royal Commission on Agriculture, 1895: 24-26). Their effects were more immediate on the corn-growing districts, but were more lasting on the foothills and uplands where marginal land reverted to moor and was not reclaimed until the 1950s or 1960s. Some of this land had initially been taken in during the Napoleonic Wars and was temporarily abandoned in the 1820s (Gibb, 1921). Hence it is possible to identify a fringe of marginal land that has been reclaimed and abandoned in response to economic conditions up to three times during the last two centuries.

Yet it is important to recognise that the nature of changes on this marginal fringe after about 1865 differs from that occurring in the eighteenth century. From this date the intake and abandonment of land was a fluctuation between moor and permanent grass, and the edge of moorland was not a limit of cultivation but of improved land. The appearance of the long ley thus introduced an intermediate zone of grassland that the Great Depression showed could act as a buffer between moorland and arable. A result of this was that changes in the prosperity of agriculture were thereafter less closely reflected in changes to the limit of cultivation.

SUMMARY OF THE CHRONOLOGY : 1600-1900

The aim of the preceding three chapters has been to establish the chronology of changes in location of the limit of cultivation by dating trends in land reclamation and land abandonment. This has enabled conclusions to be drawn concerning, first, the contemporaneity of such trends throughout the study area and, secondly, the degree to which the trends were long-term or ephemeral.

The chronology has been established by reference to three sources: to abandoned cultivation ridges and settlement sites on the relict landscape, to changes in settlement on a sequence of county maps and, finally, to a variety of manuscript and printed records. The final chronology may be summarised as follows.

The earliest concerted reclamation and settlement of the Upper Merse occurred in the eleventh and twelfth centuries and was followed by a surprisingly rapid advance over 1150-1250 A.D. onto the foothills of the Lammermuirs. By this time settlements were apparently flourishing at 300 m O.D. and land was cultivated above 350 m O.D. These elevations were reached on both lay and monastic lands on the southern Stow Uplands and in the south-eastern valleys.

Yet broad expanses of moor on the eastern foothills, on the northern Stow Uplands and on the ill-drained platforms of Gordon and Westruther remained unsettled. To the south the limit of cultivation thus exhibited a confused pattern of fingers of improved land stretching onto the Lammermuir plateau, separated from each other by extensive moorland and from lower farms by outliers of waste. In the north the edge of farmland was more simply drawn, following the foot of the escarpment from Fala to Innerwick, and rising onto the plateau only at Soutra and Spott. In these areas, then, there is firm evidence of permanent settlement and regular cultivation in the medieval era.

Prima facie evidence for permanent abandonment over 1400-1600 of this high-lying farmland is poorly supported by manuscript sources, which require more thorough examination than may be afforded by this study. For the present, therefore, the argument remains inconclusive although it is ventured that a balance of evidence, most of it indirect, points to a steady decline in prosperity and to increasing marginality of the uplands in the late medieval period.

Over the first half of the seventeenth century increasing commercialisation and expanding markets led to the intake of the low moors which had been avoided in the Middle Ages. There seems, however, to have been no advance at a high level. After 1670 there occurred a reversion of tillage and abandonment of settlement over much of the upland of the study area. More than 60 steadings were deserted before 1750, fourteen being almost certainly associated with the reversion of tillage, most of which was located on high ground above the south-eastern valleys. Much of this land had been cultivated in the medieval period and the retreat was from long-established limits of cultivation rather than from recent intakes.

Abandonment of high-lying arable land was common in the 1770s, but after 1780 the intake of moor tended to exceed losses by reversion. Reclamation increased in the 1790s and reached a peak over the period 1800-16. Much of this advance was onto lands farmed at one time during the Middle Ages and since abandoned, but some represented the break-up of virgin moor. Yet, in spite of this Napoleonic advance, the highest areas of former tillage remained beyond the limit of cultivation in 1816.

With the fall in prices large areas taken in during the Napoleonic Wars were allowed to revert over the period 1816-23, and some high land which had been cultivated regularly since about A.D. 1200 was abandoned to rough pasture. On the lower moors, however, reclamation was soon renewed and after 1835 there was steady intake of the Lammermuir foothills. The rate of advance accelerated and over 1858-77 a distinct upward movement by the limit of cultivation is discernible in the southern and eastern sectors of the study area. However, many of the new intakes were lost to moor in the following years of depression.

It is thus possible to detect a number of phases of advance and retreat by the limit of cultivation that are characteristic of the study area as a whole and reflect changes in the location of established rather than ephemeral agriculture. In Part IV a selection of factors is examined in an attempt to explain the quantity and distribution of this advance and retreat.

PART IV

THE EXPLANATION

PART IV : INTRODUCTION

It is evident that an explanation should be sought for five major phases of change in the upper limit of cultivation. First, it is necessary to establish the reasons for the elevation to which cultivation extended in the medieval period. These will provide a basis for explaining the occurrence of a second phase, that of abandonment of high land between about 1670 and 1750. Thereafter the movements of the cultivation limit appear to comprise an advance in the period 1780-1816, a brief post-war retreat and a readvance after 1835.

The explanation for these changes is sought in a selection of physical and non-physical factors which are discussed in a systematic rather than chronological fashion. Emphasis is placed on those factors which accounted for the early abandonment of high land since, first, it was this early phase that was responsible for the quantity of land abandoned in the study area and, secondly, early retreat by settlement and cultivation in Great Britain has not received the same degree of attention that has been accorded to change in the late eighteenth and early nineteenth centuries.

For these reasons Chapters 9 and 10 seek to establish the role of changes in climate in promoting movement of the cultivation limit. Chapter 11 focusses on the socio-economic determinants of the movements.

CHAPTER 9

PHYSICAL DETERMINANTS OF THE LOCATION OF THE CULTIVATION LIMIT

The location of the cultivation limit is the expression of a balance between the physical restraints on cultivation, which increase in number and degree with elevation, and the economic and social pressures working for an extension of improved land (Coppock, 1971: 43). A hypothesis which considers that shifts of the moorland edge are a sensitive indicator of change in agricultural prosperity can therefore benefit from a study of those physical forces which influence the elevation of the limit of improved land.

In this chapter the physical determinants of the cultivation limit are considered for three reasons. First, the nature of the physical restraints on upland cultivation and the gradient by which their influence increases with elevation may point to those non-physical stimuli which have promoted reclamation or abandonment in the past. Secondly, a knowledge of the physical potential of the region for cultivation or of the severity of physical restraints on cropping can aid a qualitative assessment of the strength or weakness required of economic or social stimuli to promote a change in the cultivation limit. Thirdly, a knowledge of the restraints on cultivation is a prerequisite for the analysis of climatic change.

In this chapter, therefore, those physical restraints that determine the elevation of the cultivation limit are selected. Parameters of the restraints are chosen and levels of these parameters that are critical to cereal cultivation are established. Isolines of the critical levels are drawn for the study area. These provide the basis for a discussion in Chapter 10 of the role of long-term deterioration of climate in promoting the retreat of cultivation.

THE RECOGNITION OF PHYSICAL RESTRAINT

It has been established that, prior to the broad acceptance of grasses and legumes in the late eighteenth century, peas, bere and oats were the sole crops grown on the upper slopes and foothills of the Lammermuirs (supra p.29), and of these only oats were grown on the outfield. The upper limit of cultivation was, therefore, the furthest extent of cultivation of oats. The moors above this limit were extensively grazed by sheep and cattle, an enterprise which, in view of the quantity of good grazing available on the summits, would not normally have competed for land with cereal cropping. The pre-improvement limit of cultivation was, therefore, not so much an expression of a change in the comparative advantage which tillage may have enjoyed over extensive grazing; it was the product of a cereal crop approaching the limits of its ability to tolerate an increasingly adverse environment, and of the appreciation by upland farmers of the level of this ability. Their appreciation may be based on their assessment of the probability of crop failure, of the average return of grain to seed or of other criteria.

Of the varieties of oats grown in the uplands of south-east Scotland before 1750 some are likely to have been 'black', 'grey' or 'small' oats which, by 1800, were restricted to the extreme north-west of Scotland (Morgan, 1968: 26). In the Lammermuirs these appear to have been replaced by the 'common Scotch' oat (Avena strigosa) (Hunter, 1924: 13), and by the time of the Old Statistical Account some parishes were noted as experimenting with the Red and Blainslie varieties. These early varieties of oats seem to have been shorter stemmed and less liable to shaking, but there is no evidence to suggest that they required a shorter growing season or were more tolerant of soil moisture and acidity than modern varieties now sown in the uplands of Scotland. The parameters of these factors restraining the pre-improvement limits of cultivation in south-east Scotland can therefore be judged in terms of the physiological requirements and levels of tolerance of contemporary varieties of oats.

These factors may be conveniently divided into physiographic and climatic. Of the former, the influence of elevation and location, particularly with respect to the type of climatic regime, has the strongest influence (Manley, 1945). Slope, aspect and surface roughness have been shown to be important features determining local levels of cultivation rather than the elevation (Eyre, 1954: ch.10; Taylor, 1965a). Similarly, edaphic restraints such as inadequate soil depth, water-logging or excessive acidity are secondary influences. These are often the product of an upland climate, and are essentially local controls on the limit of cultivation. Since this study is concerned, first, with synoptic rather than unique patterns of the cultivation limit and, secondly, with change in location rather than location per se, these secondary restraints are not considered in detail.

Altitudinal changes in the character of climatic factors are the fundamental controls on elevation of the cultivation limit. Insolation, exposure, warmth and wetness, especially during the growing season, are the major restraints to the uphill extension of the cropping of oats. In the following sections an attempt is made to select significant parameters of these factors and to assess their significance by comparing parametric isolines with the existing upper limit of cultivation.

INSOLATION

In maritime climates an altitudinal increase in the intensity of solar radiation is more than balanced by a reduction in the hours of bright sunshine owing to the increased occurrence of persistent cloud and mist (Klages, 1947: 270; Taylor, 1960: 3). Averages for stations in south-east Scotland (Table 9.1) indicate that the number of sunshine hours at Marchmont (152 m O.D.), Eskdalemuir (247 m O.D.) and Boghall (183 m O.D.) are generally 5 per cent lower than those for Edinburgh and North Berwick. The coastal location of the lowland stations clearly tends to compound the difference, and there is no reason to suppose a linear decrease in hours of sunshine with increasing elevation. In terms of potential for crop growth this decrease is unimportant,

Table 9.1

Annual averages of bright sunshine for selected stations in south-east Scotland, 1931-60

	m O.D.	hours
Edinburgh	23	1330
North Berwick	8	1334
Marchmont	152	1269
Boghall	183	1268
Eskdalemuir	247	1210

source: Meteorological Office, Averages of bright sunshine, 1931-60, M.O. 743, H.M.S.O., London 1963: 9-11

particularly when compared with falling temperatures and increasing wetness. At higher altitudes slope and aspect modify insolation, but their influence is marked only at the local level.

EXPOSURE

It is evident that average windspeed and exposure to south-easterly gales are important factors controlling elevation of the limit of cultivation. This influence is especially marked in coastal uplands where average windspeeds increase more rapidly with altitude than at inland sites up to 300 m (Gloyne, 1960).

Birse and Robertson (1970) have assessed the regional variation of exposure in Scotland by observing the effect of wind on single broad-leafed trees and on common heather. Five exposure categories based on these observations were found to accord well with anemometer data on average wind speed. The isolines of two average windspeeds (4.4 and 6.2 metres per second) for south-east Scotland indicate a pronounced downward tilt towards the south-east (Fig. 9.1). While similar degrees of exposure are found about 100 m higher on the Stow uplands, wide tracts of land below the 800-foot (244 m) contour are normally exposed to windspeeds exceeding 4.4 m/s on Coldingham moor and on the Upper Merse.

The explanation for the south-eastward tilt appears to lie in the shelter from prevailing westerly and south-westerly winds afforded to the north-west Lammermuirs, upper Lauderdale and Stow by the central Southern Uplands (Dight, n.d.: 2). The lowering of the isolines on the scarp of the northern Lammermuirs may reflect the increased exposure to the westerlies as they 'fan out' over the Haddington plain. The north-south orientation of shelterbelts on the scarp illustrates the dominance of this westerly component (Fig. 2.7).

In the south and east the topography encourages a backing of the wind to the south-east, to arrive chilled by the North Sea (Ragg and Futty, 1967: 10). The orientation of the Merse, and of the south-eastern valleys, allows these winds to penetrate a large area of the southern Lammermuirs. The alignment of shelter belts indicates that the restraining influence of the south-easterly gales on upland cultivation is felt up to 25 km inland.

The south-east tilt of the exposure isoline is similar to that of the moorland edge itself which may suggest a causal relationship between upland cultivation and levels of exposure. The direct comparison of the 4.4 m/s line and the limit of cultivation in 1860 (Fig. 9.2) shows them to be remarkably coincident. This pattern accords with the conclusion of McVean and Ratcliffe (1962) that the north-west shelving of vegetation in the Scottish Highlands may be linked with regional variations in the severity of exposure and in the lack of summer warmth.

The relationship between exposure and elevation in the Lammermuirs is almost linear. It is evident that, at lower levels, average windspeed increases by 1 m/s over a 70 m rise in elevation while at altitudes of 200 m and over, the gradient approximates 1 m/s over 80 m. This steady uphill loss of potential for crop growth owing to increased exposure contributes to the development of a belt of foothill, sometimes wide in areas of subdued relief, which is climatically marginal to cereal cultivation and over which the limit of cultivation has tended to fluctuate.

The influence of windspeed on plant growth is most frequently felt through increased rates of transpiration, but adverse effects may be expected to be less for plants in maritime upland areas that are not short of water. For cereal crops, particularly oats, which are most susceptible to shaking of grain, mechanical damage caused by gusts and eddies may be the more important restraint. The high frequency of south-easterly gales at St Abb's Head (GR 915695) is therefore the most likely reason for the expanse of moor at Coldingham. Local variation in wind velocity, which Eyre (1954) has attributed to surface irregularities, is influential only in determining local patterns.

Some conclusions may be drawn from this discussion:

1. Isolines of average windspeed may be used to define a fringe of foothill which is marginal to the cropping of oats because of exposure. They may contribute to an understanding of the spatial pattern of the cultivation limit.

2. The importance of exposure as a restraint on the cultivation of oats

i) points to some innovations in agriculture which may have encouraged the uphill extensions of cultivation. The most significant of these may have been the planting of shelter-belts in the late eighteenth century

ii) suggests that long-term shifts of wind direction and wind-speed may have influenced the location of the cultivation limit. These are discussed in the following chapter.

SUMMER WETNESS

The influence of excess wetness in the Lammermuirs is less marked than that of exposure and inadequate summer warmth. Sheltered from the westerlies by the Moorfoots and central Southern Uplands, the highest peaks of the Lammermuirs (527 m O.D.) receive a mean annual rainfall of only 126.5 cm (supra p.23). The physiological limits of persistent wetting and relative humidity, of which oats are particularly tolerant (Klages, 1947: 373; Ventskevich, 1961: 97), are therefore not found in the study area. For example, in Trotternish (north Skye) oats were cultivated until recently near the 200 cm isohyet.

However, lowered temperatures and reduced evapo-transpiration, associated with increased rainfall, promote a steep gradient of soil moisture which increases with elevation, and the greater sensitivity of oats to waterlogging places an absolute limit to the cultivation of oats at about 425 m O.D. in the Lammermuirs. Consideration of temperature (infra p.285) will show that absolute levels of inadequate summer warmth are reached well before those of excess moisture. But it is evident that the increase in wetness with altitude contributes to the total restraint placed on upland cultivation, and explains some of the discrepancies between the moorland edge and the isolines of accumulated warmth.

On the lower slopes where bere was extensively grown wetness was a more specific deterrent. Indeed, on the ill-drained areas of these foothills it was singled out as the major restraint. The incumbent of a hill parish noted in the Statistical Account that

> A wet season is what most of all awakens the fears of the farmers of Westruther; and where it does not prove ruinous to their hopes, leads invariably to a late harvest
> (OSA: VII: 112)

On higher land, an important indirect effect of excess moisture is felt through the podzolisation, gleying and leaching of well-drained soils, otherwise marginally suitable to cropping. The critical pH values for rye grass and oats, 4.2 and 4.3 (Scola, 1944: 151), are not reached in the A horizons of soils on most of the Lammermuir plateau (Ragg, 1960: 233); and the authors of the county memoirs of the first Land Utilization Survey for the Lothians and Berwickshire both considered rainfall a restraint to the cultivation of barley in the uplands as much through its inducement of soil acidity as through its effects on soil moisture, air humidity and cloudiness.

It is possible that the rainfall regime of south-east Scotland, with twin maxima in August and October, also militates against upland cultivation. While the dry Septembers are beneficial to ripening of crops on the Haddington plain and in the Merse, at higher levels the harvest inevitably continues into the October rains.

Prima facie evidence thus warrants a brief consideration of excess moisture as a restraint on upland cultivation. In the following section isolines of a parameter of moisture are compared with the moorland edge in an attempt to assess the role of wetness in determining the location and spatial pattern of the limit of cultivation.

Selection of the parameter

In Scotland Birse and Dry (1970) have mapped isolines of potential water deficit, a parameter devised by Green (1954) to assess the total deficit for those months in which potential transpiration exceeds rainfall. On the Haddington plain the period of deficit extends from April to July, and is a satisfactory measure of the effective wetness of the summer climate. However, at elevations of over 225 m O.D. only May and June exhibit a water deficit. To extend the use of this parameter to areas at the limit of cultivation (250-300 m O.D.) would be to measure the water balance over only a short period in early summer. Excess moisture in spring and early summer may delay the rise in soil temperatures and the preparation of the land (Taylor, 1958: 7). But wetness in late summer is a greater handicap to cereal cropping at elevation through its delay of the harvest.

Measurement of the number of rain-days is a useful index of the persistent wetting in late summer which apparently increases with altitude and is a major deterrent to crop ripening. Few stations, however, record this data, and their detailed relationship with altitude, aspect and annual rainfall is uncertain.

The obvious importance of soil moisture to cultivation at a time prior to the introduction of sub-soil drainage, and the value of potential transpiration, being a product of a number of agents which are in themselves important to crop growth, suggest the retention of a measure of potential water balance, but one which is applied over the whole growing season. The most suitable parameter for a moist upland is an 'end-of-summer' (September 30) potential water surplus. This is the excess of middle and late summer surplus over an early summer deficit. The measure, illustrated for an upland Lammermuir Station (Fig. 9.3), provides an indication of the quantity of excess soil moisture that it is necessary to drain off if waterlogging and probable crop failure are to be avoided.

Accuracy

Based as it is on county averages of potential transpiration, and on corrections for a linear decrease with altitude when there is no reason to presuppose such a relationship (MAFF. 1967: 4), an accumulated September PWS incorporates similar inaccuracies to Green's PWD. Averages of bright sunshine are available for only three stations in south-east Scotland, and two of these have coastal locations (Meteorological Office, 1963a). Moreover, total inaccuracy may reach $\pm$10 mm in the initial data of mean monthly rainfall and $\pm$ 15 m in correction for altitudinal change in potential transpiration. These can be resolved into a total expected inaccuracy of about $\pm$2.5 mm PWS. Isolines of PWS can therefore be located, with some precision, only to the nearest 5 mm. Despite these drawbacks, however, the new parameter does provide a measure of water balance for the whole rather than part of the summer. The total surplus accumulated by the end of September is an indication of the build-up of late summer wetness that is clearly important in delaying upland harvests.

The pattern of isolines

Figure 9.4 is based on 1916-50 averages of mean monthly rainfall for 22 stations. A study of short-term changes in rainfall normals indicates that, in Scotland and northern England, averages for the period 1916-50 are similar to those for 1856-95, the period used in the following analysis of accumulated warmth (Glasspole, 1933; Glasspole, 1941; Goldie and Carter, 1940). The maps of potential water surplus can, therefore, be compared directly with those of accumulated temperature.

Mean annual rainfall increases in the Lammermuirs towards the south-west, the 75 mm isohyet being about 15 m higher on the north scarp than on the southern slopes. Moreover, the average potential transpiration for East Lothian is 5 per cent greater than that for Berwickshire. As a result of these differences the isolines of PWS are tilted 50 m downward to the south and west. The pattern of this tilt is illustrated in Figure 9.4. Consequent on this is the unequal distribution of marginal land around the edge of the Lammermuir plateau.

Sixty mm and 20 mm PWS isolines have been selected to represent the approximate upper and lower margins of an area over which the limit of cultivation is known to have fluctuated. They are neither absolute physiological nor economic boundaries to cereal cropping, but may be used to define loosely a foothill fringe which is evidently marginal to cultivation owing to excess soil moisture. The higher elevation of the isolines in the north has located both 20 mm and 60 mm values on the steep scarp face, while to the south and south-east they are placed on the lower and shallow sloping 'higher lowland peneplain'. Consequently, land which is marginal due to wetness is limited in extent in the north, but is extensive on the Upper Merse and at Coldingham (Fig. 9.4); and since movement of the cultivation limit has been most marked in the latter areas the suggestion is that soil moisture is an important restraint on cereal cropping. The coincidence between the limit of cultivation and the 20 mm PWS isoline confirms this suggestion (Fig. 9.5). Their correlation in the north-east and south-east sectors of the region appears to account in part for the tilt of the moorland edge. It should be noted that discrepant areas such as the moorland at Coldingham and Gordon have been explained by excess exposure (Fig. 9.1). However, large stretches of the Stow Uplands and upper Lauderdale, which are evidently characterised by high levels of summer soil moisture, have been under continual cultivation since the Middle Ages. Here, aspect and slope appear to have favoured transpiration and drainage.

The conclusion is that soil moisture is an important contributory factor to the location of the cultivation limit, its role being largely dictated by its association with other restraints. It seems that excess moisture is an absolute physiological limit to upland cultivation only in exposed regions of inadequate slope and, consequently, soil mineral imbalance. In other areas extremes of temperature and exposure are reached before wetness becomes excessive.

The gradient of rising soil moisture tends to steepen slightly with increasing elevation. Up to the 30 mm isoline (225-275 m O.D.) potential water surplus is raised 10 mm every 30 m; above this by 10 mm over 15 m. The gradient is not so steep as to prevent the existence of a marginal fringe of wet land but it emphasizes the increasing restrictions that must be overcome for cereal cultivation to be successful at high level.

Emphasis on soil wetness points to the significance of two innovations of the early nineteenth century in extending upland cultivation; the introduction of sub-soil drainage and of moisture-tolerant grasses and legumes. Their role is discussed in Chapter 11.

SUMMER WARMTH

In maritime sites the slow rise in mean spring temperatures leads to a retarded and low summer maximum. The shallow curve of the mean annual temperature regime results in marked falls in mean temperature with moderate increases in altitude (Taylor, 1960: 2). These changes are compounded, for the greatest difference between mean temperatures of upland and lowland maritime sites occurs in late April and May (Manley, 1952). Altitudinal foreshortening of the growing season is, therefore, particularly rapid in maritime areas. Manley (1945) compares a ten-day reduction of the season over an altitudinal rise of only 76 m in southern Scotland, with a similar reduction over 130 m in the Harz Mountains.

Moreover, increasing elevation leads to a proportionally greater reduction of intensity of summer warmth in maritime than in continental climates (Taylor, 1965b). The consequent increase in its annual variability (Manley, 1951) contributes to the rapid altitudinal fall in potential for crop growth. Taylor (1960: 1-3) has emphasised also the role of associated factors, such as a lowered cloud base, reduced sunshine and higher humidity, which exaggerate the effects of lowered temperatures by reducing evaporation and transpiration.

The maritime temperature regime of south-east Scotland is therefore responsible for rapid changes in summer warmth with altitude. Manley (1945: 416) has noted how these changes are expressed in the pattern of land use

> ... just south of Edinburgh where, within a very few miles and with a change of a mere thousand feet in altitude, the transition can be seen from prosperous arable farming with a good deal of wheat, through a stock-raising belt, to bare upland country scarcely capable of carrying an occasional sheep.

Extreme maritime influence and exaggerated relief result in even greater changes of land use over small distances in the glens of the western Highlands. A product of this pattern is that, over much of the uplands of Scotland, the fringe of marginal land is too narrow to allow a wide movement of the moorland edge in response to changing economic and social conditions. Very strong stimuli would be required to overcome the steep gradient of physical restraints and to promote a considerable intake or reversion of land. In the Lammermuirs, however, the particularly shallow slopes and subdued relief of all but the northern scarp allow the limit of cultivation to advance and regress over wide areas of marginal land under the influence of only minor non-physical stimuli. The region is therefore a useful mirror for movements of the cultivation limit which may be less evident elsewhere.

The major implication of Manley's observation is, however, that falling temperatures are an important influence on the location of the cultivation limit and on the distribution of marginal land. The following section attempts to select a parameter of temperature, meaningful in terms of potential cereal growth, to assess its role as a restraint to upland cultivation by comparing isolines of the parameter with the moorland edge and, finally, to investigate its altitudinal gradient. The conclusions will provide a framework for the following analysis of secular climatic change.

Selection of the parameter

The availability of summer warmth for plant growth can be expressed in terms of length of the growing season or accumulated temperature above a standard minimum. Measurement of the length of growing season tells little of the range of intensity of warmth available for plant growth (Wilsey, 1962: 187). This is an important drawback for, in maritime uplands, cereal cropping is as much restricted by the lack of total warmth at high summer as by the number of growing days.

The use of a cumulative total of degrees by which the mean daily temperature exceeds the minimum for plant growth is thus particularly valuable. It takes no account of the regime of intensity of accumulated temperatures, but does provide a measure of the total loss of warmth with increased altitude. Nuttonson (1955: 352) has noted that photothermal units, the product of day-length and day-degrees, is a more accurate numerical expression of the growth-development requirements of cereals than is accumulated temperature, especially in the comparison of the growth potential of climates at different latitudes. A similar parameter which incorporates altitudinal variations of light availability and accumulated warmth would be valuable in the analysis of potential for plant growth on uplands. At the present, however, the data on light receipts at high levels are not available. Variations in day-length due to differences in latitude are insignificant in the study area.

Accumulated temperature is thus the most effective parameter available for the measurement of summer warmth in upland areas. Various cumulative heat-unit systems are outlined by Wilsey (1962: 191-5). The one selected is that followed by Gregory (1954) which multiplies the excess mean monthly temperature over a selected base by the number of days in each summer month. This method has been criticised by Shellard (1959: 1) for the use of average monthly means, some of which will give

> ... a small or zero accumulated temperature when it is obvious that on some days the temperature will have been well below or above the base temperature for part, if not all, of the time.

Shellard suggests the incorporation of the standard deviation of the monthly mean (Thom, 1954) to estimate the number of odd heating days in marginal months, and this system has been adopted by Birse and Dry (1970) for the assessment of summer warmth in Scotland.

The work of Birse and Dry has not been used in the present study for a number of reasons, the most important being that it is based on standard deviations of accumulated temperature calculated by Shellard (1959) for the period 1921-50. The coverage of stations for this period in the study area is inadequate for the accurate interpolation of isolines of day-degrees. Furthermore, it is evident that the greatest difference of standard deviations in south-east Scotland (between Edinburgh and Eskdalemuir) amounts to only 0.1°F. This is outweighed by other inaccuracies inherent in the methodology. Finally, the use of standard deviations in the calculations of accumulated temperature does not alter the relative distribution of interval isolines of day-degrees. Other factors behind the decision to re-calculate accumulated temperature will emerge from a consideration of the selection of base temperature and lapse-rate.

Base temperature

Forty-two degrees F (5.6°C) are conventionally used in Britain as the base temperature. These, however, largely relate to the onset of growth in grasses. Photosynthesis will occur in most cereals, including oats, at about 35°F (Duckham, 1963: 165). Nuttonson (1955: 380) has concluded that 40°F is the most satisfactory base for studying the response of spring wheat to temperature conditions in North America, the U.S.S.R. and Finland. As it is evident that oats require a similar temperature summation to spring wheat for sprouting and ripening (Ventskevich, 1961: 97), and as comparison will later be made with Nuttonson's work in Scandinavia, a base of 40°F was chosen for the present study. All temperature data will be presented in degrees Fahrenheit to facilitate comparison with Nuttonson's recordings.

Lapse rate

Birse and Dry (1970) have adopted the conventional fall of 1°F for every 300 feet (91.4 m). Comparison of data for Fort William and Ben Nevis, however, suggests a lapse rate of 1°F for 284 feet (86.2 m). It has also been pointed out that 'the decrease in temperature with height in the uplands of Britain is more rapid than is usually assumed' (Oliver, 1960). Table 9.2 shows that the fall in south-east Scotland averages $1^{O}F$ every 270 feet (82.4 m). This corresponds with the calculations of Linton and Snodgrass (1946: 394) for Selkirk and Peebles and of Manley (1952) for the northern Pennines. This figure was therefore accepted as appropriate for southern Scotland.

Selection of stations

The greatest inaccuracies in the mapping of accumulated temperature spring from the interpolation of isolines between stations. The distribution and number of stations for which point data are available is, therefore, as important as the method by which the parameter is calculated. Averages of mean monthly temperature are available for only six stations in south-east Scotland for the period 1931-60 and for seven stations for the period 1921-50 (Meteorological Office, 1963b: 8-9; 1953: 9). These could be supplemented by one from 1881-1915 (Meteorological Office, 1919: 5).

Data are available, however, for 28 stations, many of them with upland or foothill sites, for the period 1856-95 (Buchan, 1898: 3-42). All these were standardised for exposure by the Scottish Meteorological Society, and obvious thermometric and recording errors have been eliminated.

Average annual accumulated temperature was calculated from 1856-95 averages for 22 selected stations, and from two more recently established stations which offered data for upland sites otherwise unavailable,

Table 9.2

Lapse rate in south-east Scotland

	feet per ^{o}F	metres per ^{o}F
Lothian Plain:		
Rosewell (210 m O.D.) to North Esk Res. (350 m O.D.)	213	65
Edinburgh (84.1 m O.D.) " " "	238	73
East Linton (27 m O.D.) to Yester (128 m O.D.)	270	82
Coast - Ettrick Forest:		
Eyemouth (11 m O.D.) to The Glen (233 m O.D.)	270	82
" " to Bowhill (182 m O.D.)	270	82
Lower Merse - Ettrick Forest:		
Paxton to Milne Graden (30 m O.D.) to The Glen (233 m O.D.)	286	87
" " " to Bowhill (182 m O.D.)	270	82
Central Merse - Ettrick Forest:		
Broomlands (62 m O.D.) to The Glen (233 m O.D.)	270	82
" " to Bowhill (182 m O.D.)	270	82

Whitchester (1946-64) (Dight, n.d.) and West Linton (1931-60) (Meteorological Office, 1963b: 8-9). These data were adjusted to the nineteenth century level by building in a differential averaged for Edinburgh (Blackford Hill) and Marchmont (GR 744485). The distribution of 24 stations is dense but uneven, only one being sited above 300 m. Between-station interpolation is therefore still over-extended in some parts of the study area. Isolines of 100 day-degree F interval were drawn on 1:63,360 O.S. maps, which were reduced to 1:250,000 and generalised to accommodate inherent inaccuracies (Fig. 9.6).

These inaccuracies lie mainly in the standardised lapse rate and the original temperature data. An increase of lapse rate by 1°F per 6 m together with a 0.1°F error in the initial mean monthly temperature, the greatest errors that may be expected, are resolved into a compound error of 110 day-degrees F. Isolines can thus be drawn, with some confidence, to the nearest 100 feet (30.5 m) at elevations of less than 400 feet (122 m) and to the nearest 150 feet (45.7 m) at higher elevations.

The spatial pattern of accumulated warmth illustrated in Figure 9.6 exhibits marked regional variations that were also evident in the distribution of potential water surplus. The isolines that are located near the limit of cultivation, those of 1900-2200 day-degrees, are clustered together on the north side of the Lammermuirs but are more widely separated in the south and east. Clearly the spread of the isolines indicates the extent of land characterised by a total of summer warmth that is near to the minimum for the growth of cereal crops. It is thus evident that there is a distinct regional pattern of land which may be marginal in terms of accumulated temperature. This pattern is the product of, first, a 30 m north-south tilt in the plane of the day-degree isolines and, secondly, the contrasting relief of the northern and southern Lammermuirs. The tilt compounds the effect of relief by locating the isolines on the platforms of the Upper Merse rather than on the steeper slopes at the southern edge of the Lammermuir plateau.

The tilt of accumulated warmth

The tilting of the plane of summer warmth is less steep than that of exposure and summer wetness, and the axis of tilt appears to be mainly north-south, with only a small east-west component. Its direction is governed largely by the pattern of isotherms in April, September and October which tend to run from Aberlady Bay to Berwick on Tweed (Meteorological Office, 1952: 34-45). They reflect the warming influence of the Firth of Forth on the Lothian and Berwickshire coasts.

The south-east tilt of the moorland edge is thus partly explained by the variation in temperature between the north and south sides of the Lammermuirs. As a result, comparison of the moorland edge with the 2100 day-degree F isoline (Fig. 9.7) shows less discrepancy than it does with the 800-foot (244 m) contour (Fig. 2.6). The degree of coincidence of cultivation limit and accumulated warmth is high, although large areas of improved land stand on high areas on the Stow Uplands, and outliers of moorland at Westruther and Coldingham lie well below the 2100 day-degree F level. The suggestion seems to be that there is a local modification of air and earth temperatures by variations in exposure, insolation and wetness or by physiographic factors.

Climatic limits to cereal cultivation

The location and amount of land which is climatically marginal to the subsistence and semi-commercial cultivation of cereals can be established through an analysis of:

1. The minimum accumulated warmth required by oats. This will provide a theoretical absolute upper limit to cultivation at an earlier period.

2. The upper margin of continuous commercial cultivation of cereals. This may be used as an indicator of the lower limits to climatically marginal land.

In the following section use is made of phenology and of comparative studies of limits to cereal cropping both within the study area and elsewhere in northern Europe, in an attempt to identify areas which are marginal in terms of their summer warmth. These are considered as areas within which the limit of cultivation is likely to fluctuate.

The upper limit of marginal land

In the central Borders and the Lammermuirs it has been noted that oats ripen only with difficulty at elevations with less than 1,900 day-degrees (Linton and Snodgrass, 1946: 390; Ragg, 1960: 24). Ragg has also noted that, in the southern Lammermuirs, marginal farming is practised between levels with 185 to 200 growing days above a base of 42^{o}F, the equivalent to 2,000 to 2,200 day-degrees above a base of 40^{o}F.

However, absolute minimum levels of summer warmth for cereal cultivation may be established with greater accuracy by reference to phenological data. The lack of these data for Britain requires a comparative consideration of European information.

It is evident that the vegetative period and sum of temperature required by oats are slightly greater than those for spring wheat (Ventskevich, 1961: 97). Phenological studies of spring wheat in Finland (Nuttonson, 1955: 329) can therefore be used to assess heat requirements of oats. At two stations 50 km north of the economic limit of spring wheat cultivation, Alatornio (Lapi Province, 65°50' N) and Rovaniemi (Lapi Province, 66°30'N), the average sown-to-ripe accumulated temperature requirement for spring wheat was 1,660 and 1,598 day-degrees above a base of 40°F. Photo-thermal equivalents of these temperature summations, which take account of differences in day-length, may be used to apply the Finnish data to Scotland.

Average day-length over the sown-to-ripe period in central Finland, May 10 to September 7, is 18.20 hours and in south-east Scotland over the period April 30 to September 27 is 15.45 hours. The photo-thermal equivalent of 1,600 day-degrees is therefore $1,600.0 \times 18.20 =$ 29,120.0 photo-thermal units. The transferred minimum sown-to-ripe heat requirement in south-east Scotland is therefore $\frac{29,120.0}{15.45} = 1,884.8$ day-degrees.

This transference of phenological data from central Finland has taken account only of differences in the availability of light. Clearly differences in humidity, regime of temperature and water balance contribute to the contrast in heat requirements between the two regions and would need to be considered in a more detailed analysis. From the present treatment of Finnish phenological data, however, it is possible to suggest a sown-to-ripe requirement of warmth by spring wheat in the uplands of south-east Scotland of about 1880 day-degrees. The requirement of oats, being normally greater than that of spring wheat, is therefore at least 1,900 day-degrees F. Figure 9.8 indicates that the 1,900 isoline for 1856-95 fits reasonably closely with the highest parts of the 1860 moorland edge. Although, in some exceptionally sheltered and south-facing areas, cultivation appears to have extended just beyond the isoline, this level of summer warmth is approached but not exceeded in most parts of the Lammermuirs. Furthermore, the isoline of 1,900 day-degrees F stands at about 315-335 m O.D. in south-east Scotland. This agrees closely with observations on the difficulty of ripening oats above certain altitudes in the region (Ragg, 1960: 24).

The 1,900 day-degree F summation has therefore been chosen as the theoretical upper limit to both subsistence and commercial cereal cultivation, the level above which, under any economic circumstances, the effort and cost of oats cropping is not sufficiently rewarded. The diminishing rewards to subsistence cultivation may be judged in terms of the falling average return to seed or the increasing chance of harvest failure, and to cash cropping by the reduced net returns to capital. Since most of the abandoned land lying near the 1900 isoline was originally farmed under a subsistence system, consideration is later given to the role of the increasing probability of crop failure in limiting the uphill extension of oats cultivation.

The lower limit of marginal land

Although not essential to the present discussion of the physiological limits to upland cereal cultivation, it is interesting at this point to consider the lower limit of an area which is marginal to cereal growth in terms of its summer warmth. A knowledge of the distribution and quantity of this climatically marginal land will suggest areas in which reclamation and reversion are most likely to have taken place.

The upper limit of permanent commercial cultivation of cereals can be considered to indicate the lower edge of an area climatically marginal to cereal cropping. Below this limit summer warmth is sufficiently reliable to reward large capital inputs. It is therefore possible to locate approximately the lower edge of marginal land by

1. a comparative analysis of phenological data for stations near the northern limit of commercial spring wheat cultivation in Finland; and

2. a study of the upper limit of commercial cereal cropping in south-east Scotland.

Average sown-to-ripe heat requirements for spring wheat have been calculated by Nuttonson (1955: 329) for Nurmes (Kuopio Province, 63°33'N) and Maaninka (63°09'N) to be 1,856 and 1,878 day-degrees. If this figure is rounded to 1,850, the equivalent in south-east Scotland (allowing for difference in day-length) is 2,200 day-degrees. Actual temperature summations over the growing season in the Finnish stations averages 2,100 day-degrees F (Nuttonson, 1955: 329). A 250 day-degree margin is thus left to embrace annual fluctuations in temperature and to allow for delays in sowing and harvesting.

The 2,200 day-degree limit to commercial cropping of spring wheat is confirmed by a study of the present distribution of cereals in south-east Scotland (NLS: 1960-1966 MS maps, 2nd L.U.S.). The upper limit of both spring and winter wheat corresponds closely with the 2,450 day-degree isoline for the period 1931-60. If a 250 day-degree margin is included in this figure, the theoretical minimum requirements of summer warmth by spring wheat in the study area is 2,200 day-degrees F. It seems reasonable to conclude that this level represents the climatic limit of the present cultivation of wheat.

Average accumulated temperatures for 1931-60 are 250 day-degrees higher than for 1856-95. The 2,450 day-degree isoline for 1931-60 thus follows the 2,200 line for the mid-nineteenth century. Moreover, it is evident that the upper limit of wheat cultivation in the study area has remained at about the same elevation since 1860. It therefore stood at the 2,200 day-degree isoline in the nineteenth century with little or no margin remaining for annual variation of warmth.

It is interesting to note that the west-east tilt exhibited by the moorland edge in respect to accumulated summer warmth is repeated by the upper limit of commercial cereal cultivation, the influence of wetness and exposure tending to modify the overall pattern.

Isolines of 1,900 and 2,200 day-degrees F above a base of 40°F may thus be used to define the upper and lower limits of an area which is marginal to cereal cultivation in terms of the major climatic restraint on upland cultivation, inadequate summer warmth. The correlation between the pattern of this marginal land (Fig. 9.6) and that of the total fluctuation of the moorland edge over the period 1860-1970 (Fig. 3.9) is particularly close, the implication being that movement of the moorland edge is, in part, controlled by the distribution of marginal summer warmth.

COMBINED CLIMATIC LIMITS TO CEREAL CULTIVATION

Since it is clear that exposure and wetness tend to modify the effect of summer warmth on cereal cultivation, a more accurate picture of the climatic limits to cropping may be achieved by combining the isolines of exposure, PWS and accumulated temperature: 6.2 m/s, 60 mm PWS and 1,900 day-degrees F. In this way it is possible to define a foothill fringe which is climatically marginal to the cropping of oats (Fig. 9.9). Above the upper limit of this fringe the land is profoundly submarginal, and below the lower limit it is suitable for non-marginal commercial agriculture. The specific location of the lower limit is, of course, largely the product of the economic or social incentives operating at any one time. The upper limit, however, is an absolute one above which cultivation of oats would be impracticable under any socio-economic conditions. A comparison with Figure 3.9 indicates that almost all the fluctuation of the moorland edge between 1860 and 1970 occurred in the area defined by the climatic limits to marginal land; and since the fluctuation between moorland and improved land is one indicator of land which is economically marginal, the suggestion is that the climatic limits of marginality have been correctly selected.

THE PROBABILITY OF CROP FAILURE

It is important, however, to understand the way in which the critical levels of climatic restraint operate on subsistence cultivation of cereals for this directly influences, first, the severity of restraint (and thus the strength required of socio-economic stimuli for reclamation at high levels) and, secondly, the degree of response by subsistence agriculture to climatic change.

A causal relationship between summer warmth and the limit of subsistence cultivation worked through the farmer's appreciation of the climatic viability of cropping at particular locations. This appreciation was founded upon a number of considerations, many of which cannot be assessed; the most important may have been his intuitive understanding of the likelihood of a particularly poor harvest. Failure of the harvest, particularly in two successive years (Hoskins, 1964: 931-2), could be disastrous. The chance of outright failure may thus have been a more important factor behind a decision to reclaim or abandon land than was the average return to seed.

The farmer's estimate of this probability is likely to have been based on the frequency of crop failure in living memory and on his appreciation of both the average and the variability of the climatic characteristics of the region. If the location of the limit of cultivation was, in part, an expression of the decisions made by a number of farmers over a long period, a more meaningful assessment of the role of climatic restraints in locating the limit of cultivation can be made by resolving the isolines of accumulated temperature into isolines of the probability of crop failure. This study would also provide an insight into the levels of tolerance of early upland farmers in respect of the frequency of poor summers, and into the importance of successive runs of poor years in promoting the retreat of cultivation.

The concept of crop failure in subsistence cultivation in Scotland is largely a hypothetical one since oats can be harvested in December and, however small the return of grain, the straw was always valuable as fodder. Long delays in the harvest, however, reduce the amount and size of the grain, and increase the loss by wind-shaking. Thus although the crop may rarely fail outright, the yield may be so small that the subsistence farmer is forced to use his reserve of seed. The crop of the following year is therefore prejudiced.

By reference to diaries and journals it is possible to assess those weather conditions which may have led to long-delayed harvests. Mossman (1896-97: 63-207) notes that in the Edinburgh area in 1799

> the period from 20th of March to the 20th October was characterised by a great depression of temperature, so much so that the harvest was not generally got in till the end of November, and in the high grounds till the end of December.

Evidently this was a year in which there was even a net loss of seed grain on land near the margin of cultivation. A summer worse than that of 1799 would be likely to have led to harvest failure on high ground.

The accumulated temperature for the growing season of 1799 in Edinburgh (76 m O.D.) is estimated from published mean temperatures (Mossman, 1896-97) to have been 2,414 day-degrees F. At the upper limit of cultivation in the Lammermuirs (320 m O.D.) the sum is likely to have been about 1,750 day-degrees F, at the lower level of marginal land (c.215 m O.D.), about 2,000 day-degrees F. It can therefore be concluded that, at locations near the 1,900 day-degree isoline or the absolute upper limit of cultivation, a summer in which accumulated warmth failed to exceed 1,750 day-degrees would have led to extremely delayed and reduced cereal harvests. At locations near the upper limit of commercial cereal cropping, the 2,200 isoline, harvests in summers with not more than 2,000 day-degrees would have been delayed until late November and would not have sufficiently rewarded inputs of labour and capital.

The statistical probability of crop failure can be calculated from climatic data and an assessment can be made of the frequencies of failure which marginal farmers were prepared to tolerate.

<u>The calculation of probability</u>

Since accumulated summer temperatures vary along a normal curve it is possible to use the normal distribution function to calculate the probability of summer warmth being less than the critical value, 1,750 day-degrees.

The standard deviation of summer warmth in Edinburgh was calculated for the period 1856-95, from a set of more accurate, standardised data than that used for the construction of the day-degree isolines (Mossman, 1896-97). Consideration of the standard deviation of mean monthly temperatures calculated for a later period (Shellard, 1959) indicated that the maximum that can be expected between the stations in south-east Scotland is only about 25 day-degrees. The standard deviation of 279 for Edinburgh can therefore be considered representative of total variation in summer warmth throughout the study area. Since accumulated warmth falls with altitude the relative variability of summer warmth is greater at altitude. Thus the coefficient of variation is 10.2 per cent at

Edinburgh (76 m O.D.), but 11.9 per cent at Marchmont (152 m O.D.) and 14.7 per cent at the 1,900 day-degree isoline (c.320 m O.D.). The chance of occurrence of a cold summer clearly increases with altitude.

The probability of occurrence of a temperature summation being less than 1,750 day-degrees has been calculated for isolines of 100 day-degree intervals (Table 9.3).

Table 9.3

Probability and frequency of crop failure, by 100 day-degree intervals, in south-east Scotland (1856-95)

Critical value (x) = 1,750 day-degrees above base 40°F

Standard deviation = 279

Normal Distribution Function (d) = $\frac{x - \bar{x}}{S.D.}$

$\bar{x}$	d	probability	frequency	probability^2	frequency of 2 successive years
2400	-2.3512	0.0099	1 in 111.1	0.00009801	1 in 10203.0
2300	-1.9710	0.0244	1 in 41.0	0.0005954	1 in 1679.7
2200	-1.6130	0.0535	1 in 18.7	0.00286	1 in 349.6
2100	-1.2545	0.1050	1 in 9.5	0.0110	1 in 90.9
2000	-0.8961	0.1860	1 in 5.4	0.03460	1 in 28.9
1900	-0.5377	0.2960	1 in 3.4	0.08762	1 in 11.4

The results are illustrated in Figures 9.10 and 9.11. It is evident that the frequency of harvest failure increases exponentially with elevation and with falling summer warmth. On the zone of marginal foothill between the 2,200 and 1,900 day-degree isolines the probability of occurrence doubles with a 30 m increase in altitude. Thus at elevations of 300 m O.D. the frequency is about one year in five, while at 215 m O.D. it is approximately 1 in 20. At the theoretical climatic limit to cultivation (1,900 d/d) it is 1 in 3.4. It seems, therefore, that a frequency of harvest failure in the order of two years in seven is a major agent by which inadequate summer warmth imposes an absolute altitudinal limit on cereal cropping. A 1 in 5 frequency is probably the effective limit, this being closest to the actual limit of cropping in 1860.

The probability of the occurrence of two consecutive crop failures may be calculated by squaring the single-year probabilities (Table 9.3). It seems that a frequency of about one year per generation (25 years) was the greatest that subsistence farmers could tolerate.

There is implied in this discussion the operation of a 'theory of games' where rational decisions are made by farmers in the face of uncertain conditions by choosing strategies to maximise the certainty and quantity of return to time and effort (Gould, 1963). The increasing uncertainty of a harvest determines that the rewards to reclamation at a certain altitude do not balance the time and effort spent on cultivation, which is more profitably directed elsewhere. The level at which this balance fails to be achieved depends on the factors contributing to the uncertainties of harvest and to the availability of land elsewhere.

Considered in these terms, the widespread abandonment of upland tillage may be seen as the product of one, or of a combination of four causes:

1. an incorrect appreciation by reclaiming farmers of the suitability of the uplands for cereal cultivation;

2. a change in the levels of tolerance of low yields and the uncertain harvests, owing to the appearance of opportunities elsewhere;

3. changes in the farming system, centred on the increased intensity of cropping on lower land;

4. climatic deterioration reducing the suitability of the uplands for cereal cultivation.

It is unlikely that the first two factors account for the quantity of abandoned land found in the study area. The third factor, that of increased productivity of the land, is considered in Chapter 11. The possible importance of climatic deterioration, which may at first seem irrelevant, has been indicated by the preceding analysis and is emphasises by the exponential increase in harvest failure with elevation which is illustrated in Figure 9.11. The restraint of inadequate summer warmth works with greatly increasing effect toward the margin of improved land. Thus, at the moorland edge in south-east Scotland, a 25 m increase in elevation produces a 0.3°F fall in mean summer temperatures which corresponds to a 100 day-degree F (or 5 per cent) reduction in accumulated summer warmth. When this is resolved into the likelihood of crop failure, however, the probability of occurrence of a single critical season is almost doubled and of two consecutive critical seasons is nearly trebled. It is clear that, if a similar fall in mean summer temperature is produced by a deterioration of climate, identical increases in crop failure would occur.

It may be concluded, then, that subsistence cultivation of cereals in climatically marginal areas is particularly sensitive to both temporal and altitudinal decreases in summer warmth. Any crops of oats grown above the isoline of 1,900 day-degrees F (c.320 m O.D.) would suffer an unacceptably high frequency of failure.

THE DISTRIBUTION OF ABANDONED LAND

Yet Figure 9.12 indicates that substantial areas of abandoned land lie well above 320 m O.D. About 700 ha, or 14 per cent of all the abandoned land in the study area, are located above both the 1,900 day-degree F and 60 mm PWS isolines for 1856-95. Of this, about 200 ha stand more than 40 m over the combined limit, and at Tollis Hill (GR 520580) evidence of cultivation extends beyond 425 m O.D. At this elevation, under average conditions of the nineteenth century, accumulated summer warmth would not exceed 1,650 day-degrees F and the probability of the occurrence of severely reduced harvests would approximate 0.65. At all locations above the 1,900 day-degree/60 mm limit, with the exception of particularly sheltered, south-facing slopes, it is unlikely that the average return to seed exceeded 2:1. It is surprising, in fact, that few of the sites are well sheltered and that not all of them are south facing.

Unless there existed in the medieval era an excessive demand for unoccupied land and a willingness to tolerate a high probability of harvest failure, it is difficult to explain the elevation of the former cultivation without acknowledging the role of environmental change. The problem is highlighted by the evidence for vigorous uphill reclamation in the medieval period even while there remained areas of lower land, apparently adequately drained, lying unimproved (supra p.203).

Moreover, it is evident that much of the former cultivation was associated with settlement occupied over a number of centuries. It therefore represents the relic of long-standing, regular cropping rather than of ephemeral outfield intake which may have been abandoned because of an unrealistic assessment of its viability. Only one region of cultivation is known to have been abandoned soon after its reclamation (supra p.184), the result of an over-zealous improvement scheme in the mid-eighteenth century. There is every indication, therefore, of continued, successful cereal cultivation above 320 m O.D. in the Middle Ages.

The permanence of this cultivation is confirmed by the distribution of farmsteads established in the Middle Ages but abandoned before the eighteenth century (Fig. 9.13). Of 12 steadings which disappeared from the documentary record between 1600 and 1750 five lie on or above the absolute upper limit to cultivation of 1856-95. The remainder are distributed on the climatically marginal fringe.

A further 14 steadings were probably abandoned before 1600. The pattern of their distribution is biased since relict evidence of their location is more likely to have survived in the remote areas. It may, however, be significant that two of the sites lie at least 40 m above the 1900 day-degree isoline.

There is, therefore, evidence for the extensive cultivation and settlement of the Lammermuirs up to elevations which were totally unsuited to cereal cropping in the nineteenth century. The only thesis which satisfactorily explains this occurrence is one which accepts that secular changes in climate have shifted climatic limits to cereal cropping downwards from the level at which they stood in monastic times.

CHAPTER 10

SECULAR CLIMATIC CHANGE

A hypothesis which considers movement of the cultivation limit as an indicator of change in agricultural prosperity assumes a static physical background. Evidence is presented below to suggest that this assumption is untenable and that account must be taken of long-term climatic change. Consideration is given in this chapter to the quantity and direction of climatic change in the second millenium A.D. and to its importance as a factor in promoting movement of the upper limit of cultivation. Research into recent fluctuations of climate remains in its infancy, and none but the most general trends have been established with certainty. Perhaps because of this little consideration has been given to their implications for the history of marginal settlement and agriculture in upland Britain. For this reason an attempt is made to construct a general model of shifting climatic marginality which may be viewed as the background to fluctuations of cultivation in the Lammermuir Hills.

LONG AND SHORT-TERM FLUCTUATIONS

Economic historians have for some time been aware of the tendency for good and bad harvests 'strikingly to run in sequences of three or four' (Hoskins, 1964: 931), with the result that the chances of famine are compounded. In exceptional cases, where malnutrition has encouraged the spread of disease, least favourable lands may be abandoned by a reduced population. For example, it is evident that over half of the farm rentals in two parishes in Kintyre lay vacant in 1651 after the passage of bubonic plague in 1647-48 (McKerral, 1948).

Such sequences have been linked by H.H. Lamb (1966: 213) to periodic short-term fluctuations of weather which evidently had a profound effect on the lives of early cultivators. These tend, however, to cancel themselves out in respect to their influence on agriculture over the long term (Jones, 1964: 50). A pattern of production may, in fact, be adjusted in such a way that the farmer minimises his vulnerability to climatic uncertainty (Gould, 1963). Years of scarcity are normally balanced by periods of abundant harvest, and abandoned lands are reclaimed by a revitalised population.

There is, indeed, evidence to suggest that a short run of poor years may, in areas of commercial cereal cropping, have led to an extension rather than a contraction of the cultivated area, encouraged by poor harvests and the consequent rise of grain prices (Brandon, 1969). By contrast the subsistence farmer may have no alternative but to continue cropping the same land in spite of increases in physical adversity (Smith, 1970).

Short-term climatic change is therefore unlikely to have initiated major trends in the movement of upland settlement or the cultivation limit. However, secular change which is not accounted for by patterns of agricultural production, which occurs over several generations and which does not impose an immediately recognisable hardship on marginal farmers, is likely to have been a stronger force behind permanent change in the cultivation limit. In this case reclamation or abandonment is likely to have proceeded almost imperceptibly, based on the renewed appreciation of the viability of cereal farming in uplands by successive generations of cultivators, their awareness being more of altered economic or social circumstances than of underlying environmental change.

CLIMATIC MARGINALITY IN MARITIME AREAS

In maritime climates a small reduction of mean temperatures, caused either by a rise in altitude or by absolute deterioration, has been shown to lead to substantial falls in accumulated summer warmth. Thus, while the effect on growth potential is marked, an adjustment to falling temperature can be made by a slight lowering of the cultivation limit. The smoothed topography of the Lammermuirs, however, ensures that this lowering is effected over often a wide expanse of gently sloping foothill so that the response to a small change in climate may be manifested on a broad scale.

It is also evident that, particularly in upland areas, an overall lowering of temperatures leads to a large reduction of an already short growing season and an already low intensity of summer warmth. Marginal maritime uplands are thus especially sensitive to climatic change. Several economic historians (Bishop, 1934; Britton, 1937; Goubert, 1952, 1960; Hallam, 1954, 1961; Utterstrom, 1954, 1955) have in the past pointed to the fact that marginal or 'half-wanted' land was the first to fall out of cultivation as demand fell or as the climate deteriorated, but it has only recently been recognised that maritime upland communities in northern Britain are so critically placed in this respect (Jones, 1964: 58; Taylor, J.A., 1965b: 94; Oliver, J., 1965). One of the reasons for this is the tendency in Britain for cold autumns to follow cold, wet springs. While in southern England cold autumns are normally dry, in Scotland they are generally wet (Smith, 1965). Climatic deterioration in Scotland, therefore, is linked with the onset of cold and wetness at both ends of the growing season, leading to a compounded decline in potential for crop growth. Thus E.L. Jones (1964: 58) has noticed the closer correlation between climatic marginality, crop failure and population trends in upland Scotland and Sweden than in lowland England. Beaver (Lamb, 1970) and Smith (1970) have recently emphasised the especial significance of climatic change to 'fringe areas' where agricultural systems are poorly adapted to climatic conditions. Smith (1970: 361) notes that these are 'threshold zones where small climatic changes imply large climatic effects'.

Finally, it is likely that climatic deterioration, particularly the increased frequency of wet autumns, reduced the cropping potential of moist upland soils more severely before the introduction of sub-soil drainage. Reliance on often inadequate ridging of the land increased the chance of waterlogged soils in wet seasons. It is therefore evident that climatic change, particularly in marginal, maritime uplands before the nineteenth century, could have been an important factor behind the fluctuation of cultivation.

THE LITERATURE REVIEWED

Early theories linking secular climatic change with economic cycles (Beveridge, 1921) were discredited by initial investigations into climatic fluctuation (Britton, 1937: 177) and were rejected by most economic historians (Russell, 1948; Postan, 1950). These arguments, while being perpetuated by the work of more recent writers (Van Bath, 1963: 161; and Jones, 1964: 131) are still based on early climatic chronologies now largely superceded by the work of Lamb (1966). Britton's chronology, based on the occurrence of extreme floods and heavy snowfalls, indicated that the prosperous era of the early medieval period, 1150-1300, was more especially marked by bad weather than the later period of economic decline, 1300-1450. Yet Lamb (1966: 219) has shown that climatic deterioration, although starting soon after 1200, accelerated in the late medieval era and coincided with a history of economic depression. Moreover, there is now abundant evidence for the lowering of the upper limit of viticulture in western Europe over the period 1300-1430 during which it was earlier thought that the expansion of vineyards contradicted general economic trends (Lamb, 1966: 189).

Higher cereal yields and a fall in grain prices during the climatic deterioration of the 14th century have also been used to discredit the role of climatic change (Van Bath, 1963: 161), but fresh evidence for the contraction of arable lands at this time (Baker, 1966) suggests the cropping of cereals only on the more suitable soils, the increase of the crop-to-livestock ratio and, probably, of the manuring of infields, developments which would encourage higher yields though reduced gross production. The fall in cereal prices is, in fact, not significant until after 1379 and is likely to be a result of reduced demand following the Black Death.

Much of the basis for earlier conclusions about the irrelevance of climatic change to economic history can thus be discounted. Yet few agricultural historians have renewed the argument. Some have recognised the connection between poor harvests, malnutrition and plague, particularly in respect of the Black Death but emphasis has been laid more on population decline than on climatic deterioration as the direct agent of land abandonment (Beresford, 1969; Brandon, 1969; Hoskins, 1964; Hoskins and Finberg, 1952: 318; Smout, 1969: 153-4; Van Bath, 1963: 89). There are, however, some exceptions, notably the explanation by Jones (Jones, 1965) of early settlement in Snowdonia and by Phillips (Phillips, 1963:126) of the abandonment of village sites on marginal land. Apart from a number of climatologists (Lamb, 1966 and 1970; Manley, 1951; Smith, 1970) who have alluded to the agricultural implications of climatic deterioration, Steensberg (1970) is alone in explicitly linking developments in agriculture with climatic change. He has suggested that the lengthening of fallows in Scotland and northern England and the introduction of plough ridges on moist land in eastern Europe represented a response to an increased frequency of colder and damper summers after 1200.

It is thus surprising that, while archaeologists have often referred to the climatic optimum in the Bronze and early Iron Ages for an explanation of early upland cultivation and settlement, and to the coincidence between the decline to a moist Sub-Atlantic climate and the abandonment of upland sites (Raistrick, 1969: 32-44; Phillips, 1963: 58), agricultural historians have not accepted that modern climatic fluctuations may have played a recognisable role in the history of marginal cultivation. There is, however, some evidence to suggest that this role has been more than passive.

DOCUMENTARY EVIDENCE

There is little written evidence for the retreat of cultivation as a result of a deteriorating climate. An important source, however, is the suggestion by jurors of the Nonarum Inquisitiones that climatic hazards were one of the causes for the reversion of arable land in central England in the early fourteenth century (Baker, 1970). There are also extant accounts of the abandonment of farmland in Iceland in the late seventeenth century owing to the encroachment of glaciers (Eythorsson, 1952) and accounts of the retreat of cultivation in Norway and Sweden in the decades of 1590 and 1690 owing to frequent failure of harvests (Utterstrom, 1955).

BOTANICAL EVIDENCE

Comparative evidence from trends in the location of certain plant species, both within the study area and in Europe as a whole, provides a useful indicator of the likely response of cereal cropping to a changing climate.

Scotland

Over much of the northern and western parts of Great Britain the present retreat of blanket peat is revealing Bronze and early Iron Age settlement sites that have been obscured for the last two millenia (Phillips, 1963: 129, 141; Evans, 1970), the wasting being attributed most commonly to over-grazing, excessive burning or the development of a drier climate since the eighteenth century (McVean and Lockie, 1969: 30). In the Lammermuirs and Cheviots, Fenton has noted a similar process, which he associates with the spread of bracken and the retarded recovery of heather after burning, and which he links with an amelioration of climate (Fenton, 1951b: 39, 45; 1952: 22-23). Moreover, reference has already been made (supra p.210) to Penshiel in the central Lammermuirs (339 m O.D., GR 639627) where the retreat of hill peat is revealing traces of cultivation ridges possibly associated with a monastic grange. This points to the development of increasingly cold and moist conditions in the post-medieval period, prior to a more recent amelioration. In a similar way, Durno and McVean (1959) allude to the decline in the extent of forest cover over the period 1300-1500 in the Beinn Eighe Nature Reserve. This may have resulted from a combination of environmental and anthropogenic processes.

Europe

Moreover, in central Europe a comparable lowering of the tree line by 70 to 200 m over the same period has been clearly attributed to climatic deterioration (Lamb, 1966: 189). Relict woodland in Iceland almost disappeared at this time (Lamb, 1966: 65).

Pollen counts

Evidence from pollen analysis is often inconclusive since it is rarely tied to an absolute time scale. In South Wales, however, both upland

and lowland peats indicate widespread cultivation in the twelfth and thirteenth centuries with reversion after 1800 (Moore, 1965; Turner, 1965). Moreover, in the Durham Pennines present work by Roberts, Turner and Ward (1972) on pollen studies of an early farming site may point to the contraction of cereal cultivation in the fourteenth century in response to wetter conditions on the moorlands.

EVIDENCE FROM TRENDS IN CULTIVATION

The coincidence between developments in agriculture and known climatic fluctuations is further evidence of the influence of environmental change.

The increased frequency of poor wine harvests in Germany after 1250, accelerating to a peak in 1550-1690, and the final abandonment of the last English vineyards after 1300 fall in line with the late medieval climatic deterioration which reached its nadir in the late sixteenth and the seventeenth centuries (Lamb, 1966).

Moreover, the periods of maximum advance and widespread reversion of cultivation on British and European uplands coincide with the major trends of change in climate. The phase of reclamation in the Middle Ages, which pushed the limit of cultivation to its furthest extent by 1300 in the northern Pennines (Beresford, 1951: 129-49) and the North York Moors (Beresford, 1969), occurred during the Second Climatic Optimum, 1100 to 1300; and over the period 1300-1700 the abandonment of land, which may have accelerated in the late fifteenth century, coincides with a known climatic deterioration. In most countries of western and northern

Europe the contraction of tillage and conversion to pasture, waste or industrial cropping are evident at this time (Van Bath, 1963: 69; Steensberg, 1970). The deceleration of the processes of enclosure and depopulation, noted by Beresford (1951: 145) to have occurred after 1520, is observed by Lamb (1966: 175) since it coincides with the only temporary climatic recovery which occurred between 1300 and 1600.

In Scotland it seems that little further reclamation was undertaken by the monasteries after 1350 (Franklin, 1952: 28). The frequent reports of difficult weather and dearth of crops in the Annals of Dunfermline Abbey, and the declining fortunes of the Earldom of Mar around 1426, contrast with the bold expansion of monastic lands in the twelfth and thirteenth centuries (Lamb, 1966: 163).

In the study area it has been noted that reversion of upland tillage was most widespread in the late seventeenth and early eighteenth centuries, a period, it will be seen (infra p.327), that was characterised by abnormally cold and wet summers.

There is, therefore, some _prima facie_ evidence to suggest that agricultural change is linked with climatic fluctuation and that the response by marginal cultivation may have been marked. This evidence has been presented in detail since the case for a causal connection between the two has not previously been fully argued. It is clear, however, that an examination of secular climatic change may partly explain the retreat and advance of cultivation limits in the Lammermuirs. Furthermore, it may allow the identification of a marginal fringe of land over which the climatic limits to cropping of oats have shifted. In the following section information on climatic change is resolved into isoline movements of the parameters of summer warmth and wetness. The quantity and direction of movement are compared with known shifts of the cultivation limit in an attempt to test for a causal relationship.

MEASURING SECULAR CLIMATIC CHANGE

The following analysis is based on the only comprehensive data which are available on modern climatic change, the product of research by H.H. Lamb (1966). As far as possible they has been checked for their application to south-east Scotland and for degree of accuracy.

Sources

Lamb has drawn on a variety of published and manuscript materials, and on physical indicators to assess changes in temperature and rainfall. Recorded averages of temperature are available for central England, standardised by Manley (1953), for Utrecht and for Edinburgh (Mossman, 1896-97) from the early eighteenth century. Averages of rainfall are available for England and Wales from 1727 (Nicholas and Glasspole, 1931) and for Edinburgh from 1770 (Mossman, 1896-97). Early chronologies of the major climatic hazards (Britton, 1937; Brooks and Glasspole, 1927) have been supplemented by a systematic study of original weather records for northern Europe for the period 800-1750. Published studies of palynology, varves, glacial and sea-level movements, tree-lines and C^{14} dating provide an outline of pre-eighteenth century change to which the early documents bring detail (Lamb, 1963).

Accuracy of established trends

From these sources Lamb established trends in 'high' summer rainfall and winter temperature, these trends being the occurrences most likely to have been accurately recorded in early manuscripts and which indicate changing cyclonic and anticyclonic conditions (1966: 181). It is evident that only the largest changes can be regarded with a 99 per cent level of confidence; these include the particularly mild winters between 1500 and 1550, the severe period during the seventeenth century and the 'high' summer rainfall in the late fourteenth and throughout the sixteenth centuries. Changes in annual temperature and rainfall are less firmly established, being based on an interpretation of pressure conditions indicated by summer rain and winter cold. Overall trends, however, are reliable and, indeed, are the only ones available.

Regional variation

The changes established for central England are accepted by Lamb (1966: 157) as common to Scotland and the remainder of north-west Europe. Moreover, Manley (1953) has found that even the short-term anomalies of temperature found in his reductions for the English Midlands are also evident in Mossman's (1896-97) series for Edinburgh. Short-term trends in rainfall, even between the sub-regions of Scotland, tend to exhibit greater disparities, although almost all of these disappear when they are smoothed over ten-year means (Goldie and Carter, 1940: 93-97).

Thus some of the doubts expressed over the use of English records, particularly with respect to the study of climatic change in upland Wales

(Oliver, 1965: Taylor, 1965b: 94-95), are unfounded. Both temperature and rainfall, considered over 50-year means, exhibit similar changes throughout the British Isles, and the general trends established for central England can, with some confidence, be used for south-east Scotland.

Changing parameters of growth potential

Lamb (1966) has calculated that both average 'high' summer and average mean annual temperatures fell by about 2.0°F over the period 1300 to 1600, and that there were corresponding changes in summer rainfall. The implications of these changes for upland cultivation can be assessed by resolving the trends into those of accumulated temperature and potential water surplus.

Accumulated temperature was chosen as the parameter of summer warmth since it is evident that, especially at higher levels, annual variation in the intensity of warmth is greater than in the length of growing season (Manley, 1951). Estimates of the mean temperatures of 'growing months' were made by interpolating between 'high' summer and winter along a curve of temperature regime typical for upland south-east Scotland. These were converted into a temperature accumulation above a 40°F base and expressed as a deviation from the 1856-95 normal (Fig.10.1).

Changes in mean monthly rainfall and potential transpiration over the growing season were similarly established, transpiration rates being assumed to alter almost linearly with rainfall through humidity, cloudiness and radiation. The close correlation between summer temperature and summer rainfall in Scotland makes this assumption tenable. An end-of-summer potential water balance was calculated for selected dates and expressed as a deviation from the 1856-95 normal. Those dates chosen for calculation are broadly representative of the major fluctuations of temperature and rainfall. From these points, and by reference to the trends detected by Lamb (1966: 186-7), smoothed 50-year trends of summer warmth and wetness were drawn for the period 1100-1950 for sites at the 1,900 day-degree isoline (c.320 m O.D.) in south-east Scotland (Figs. 10.1, 10.2).

Changes in exposure, particularly in the frequency of north-easterly winds, have been closely associated with fluctuations of temperature and rainfall (Lamb, 1966: 138, 167, 210-11), but it has not been possible to quantify the changes as average windspeeds. Moreover, an assessment of the importance of changing exposure is complicated by the recent introduction of oat varieties less susceptible to wind damage.

Trends in summer warmth and wetness

Figures 10.1 and 10.2 illustrate fluctuations in warmth and wetness which fall into four phases: a 'secondary climatic optimum' (1150 to 1250), a medieval climatic deterioration (1250 to 1550), a cold epoch (1550 to 1700) and a recent amelioration. The characteristics of these phases are outlined below.

Persistent amelioration after the Roman era reached a secondary optimum in the Middle Ages characterised by both a high accumulation of summer warmth and a low end-of-summer potential water surplus. The average levels of warmth and wetness at 320 m O.D. in the Lammermuirs in the thirteenth century were prevailing at elevations of only 200 m O.D. in the mid-nineteenth century. The climatic limit to cultivation stood at over 450 m O.D. rather than at 320 m. The high frequency of anticyclonic influence in summer is likely to have resulted in the dominance of westerly or south-westerly winds, associated with very low levels of exposure in upland eastern Scotland.

A steady climatic deterioration is evident in the late Middle Ages, as a result of a southward shift of the northern Atlantic depression tracks and reduced anticyclonic activity (Lamb, 1966: 184, 211). A consequent change in the annual distribution of rainfall, particularly increased wetness in 'high' summer and autumn, was associated with a lowering of accumulated temperatures. Over two centuries average summer warmth fell by 350 day-degrees F and end-of-summer potential water surplus increased by about 70 mm. Both changes are equivalent to a rise in elevation in the Lammermuirs of 140 m. The increased frequency of cyclonic north-easterlies is likely to have resulted in the greater exposure of the coastal moors. Summer wetness, already exaggerated by reduced evaporation, was compounded by the high incidence of especially damp autumns (Lamb, 1966: 92) so that cloudiness and soil waterlogging would have severely delayed the cereal harvest in upland areas.

The deterioration was temporarily checked by a short period of fewer wet summers (Lamb, 1966: 218), which is reflected in a more marked warming of the growing season. After 1530, however, the deterioration continued with an increased incidence of wet summers, manifesting itself as a 10 per cent increase in mean 'high' summer rainfall and a 0.6°F fall in mean 'high' summer temperature over the period 1530-1600. The particularly high frequency of wet autumns between 1650-1700, the nadir of the cold epoch, is likely to be associated with the famine of the 1690s. In fifty years the intensity of average summer warmth at 320 m O.D. fell by 6 per cent and the growing season was shortened by six days, the equivalent of a 60-metre increase in altitude. Lamb (1966: 212) has noted that the

> pessimum climate of A.D. 1550-1770 ... was probably a good deal colder than any previous cold phase since the major Post-Glacial warm epoch in 5000-3000 B.C.

The effects of this climatic deterioration are likely to have been felt mostly on poorly drained foothills where increased precipitation and reduced evaporation resulted in autumn waterlogging, and on uplands where lowered temperatures, increased cloudiness and humidity discouraged the ripening of cereals.

Since 1870 a trend toward warmer and slightly drier summers has once more placed average growing conditions at the level they stood in the fourteenth century, although conditions prevailing in the period 1856-95 were more similar to those characteristic of the early sixteenth century.

The secular trends outlined above do not illustrate short-term fluctuations which would have extended the range of warmth and wetness experienced by upland farmers. Moreover, not all the trends themselves are firmly established. But they may be used as a framework for the analysis of the possible effect of a slowly changing environment on the upper limit of cultivation.

CLIMATIC CHANGE AND MARGINAL LAND

Changes in site viability and in probability of harvest failure

The implication in these trends is that, with the fluctuation of potential for upland plant growth, the theoretical climatic limit to cultivation has risen and fallen substantial distances over the last millenium. Some high-lying farmland, near the present cultivation limit, has therefore at one time been climatically sub-marginal and at another supra-marginal. It is possible to determine the dates at which these changes in the marginality of land occurred by reference to the trend line of summer warmth (Fig. 10.1). This illustrates that land at the climatic margin of cereal cultivation in 1856-95 experienced a mean summer warmth in the optimum period (1150-1250) of over 2,200 day degrees. Even commercial cereal cultivation would thus have been possible at levels of over 300 m O.D. in the early medieval period. The average frequency of crop failure was less than one year in twenty (Fig. 10.1).

Deteriorating conditions in the late medieval era probably increased this frequency to 1 in 5 by the mid-fourteenth and to more than 1 in 3 by the mid-fifteenth century. The high-lying lands in south-east Scotland probably became sub-marginal to commercial cereal cropping after about 1250. Indeed, at the nadir of the cold epoch the mean summer warmth was 1,750 day-degrees, offering only an even chance to the full ripening of oats. At that time it was therefore sub-marginal even to subsistence cultivation. The steady amelioration since 1700 had returned the moorland at 300 m O.D. to the fringe of climatic marginality by the mid-nineteenth century.

The suggestion is therefore that, if Lamb's estimate of secular changes are correct, the alteration to potential for crop growth in marginal, maritime uplands has been of sufficient scale to promote reclamation and subsequent abandonment. The areas in which these changes in land use may have been promoted can be identified by studying the movements of the parametric isolines of summer warmth and summer wetness.

Moving climatic limits to cultivation

Figures 10.3 and 10.4 illustrate at selected dates the changing location over the last millenium of the absolute climatic limit to cultivation, the combined isolines of 1,900 day-degrees F and 60 mm PWS. The shift of these isolines indicates the quantity and location of land whose marginal status may have been altered by secular changes in climate.

During the Second Climatic Optimum, 1150-1250, the limit to cultivation in the Lammermuirs stood at 425 m to 450 m O.D. By 1300, at the onset of the medieval deterioration, the elevation of the limits had fallen by about 15-30 m but it is evident (Fig. 10.3) that almost all the Stow Uplands, Fala Moor and the eastern Lammermuirs were still suited to cereal cropping.

The late medieval deterioration promoted a fall of the combined parameters by 75-90 m and the uncultivable upland core was more than doubled in area to 295 km^2. Much of this submarginality was created in those parts of the Stow Uplands and Lauderdale lying above 300 m O.D., areas which in the early Middle Ages may have been particularly suited to cultivation by their well-drained slopes and southerly aspect.

By 1600, which is broadly representative of average conditions existing in the cold epoch during the seventeenth century, the limits of excessive PWS had fallen to 210 m O.D. rendering much of the ill-drained platforms at Gordon and Westruther almost certainly uncultivable. The more exposed areas of Coldingham and Abbey St Bathans probably became unfavourable owing to the increased frequency of northerly and easterly gales. The combined limits to cereal cropping fell to 260-275 m O.D. in Stow and Lauder and to just over 275 m O.D. on the northern slopes of the Lammermuirs. In this short but swifter climatic decline, which reached its nadir in the 1690s, at least 150 km^2 of foothill became sub-marginal to the cultivation of cereals owing to inadequate warmth and excessive spring and autumn wetness.

It is also possible to trace the spatial component of the modern amelioration by a study of the theoretical uphill advance of critical warmth and moisture levels (Fig. 10.4). Since the late nineteenth century slowly rising mean temperatures have brought large areas of the Lammermuir Hills (about 150 km^2 in the last half-century) within the minimum heat requirements for the ripening of oats. A smaller fall in PWS, however, has ensured that they remain too moist for successful cropping.

It is thus possible to locate and measure the fringe areas of upland whose status as potential agricultural land has depended on changes in climate. Consideration is now given to the causal relationship between change in climate and change in the limit of cultivation.

CLIMATIC CHANGE AND THE LIMIT OF CULTIVATION

Locating historically marginal land

The foothill zone over which the critical levels of climatic parameters have shifted in the last millenium represents an upland fringe which is 'historically marginal' (Fig. 10.5). This defines the maximum area over which the moorland edge can be expected to have fluctuated in response to secular climatic change. It reflects a vertical fall in the theoretical limit to cultivation of 140 m between 1300 and 1600, which is mirrored by a ten-fold increase in the probability of crop failure on high-lying farmland.

Clearly this scale of change, occurring on the sensitive margins of cultivation, may have been sufficient to stimulate a response in agriculture. Indeed, it is apparent from Figure 10.5 that most of the land abandoned before 1860 is contained by the isolines of 1300 and 1600. Thus, if our present knowledge of changes in climate is correct, the highest plots of abandoned land lay just below the climatic limit to cultivation as it stood over the period 1100-1350, and well below that of the peak period 1200-70. The suggestion of a causal connection between deterioration of climate and retreat of cultivation is thus strengthened. In the following section this hypothesis is tested.

Climatic deterioration and land abandonment

The secondary climatic optimum

Evidence for the elevations to which settlement and reclamation had pressed by the twelfth and thirteenth centuries is limited by the lack of extant documents. However, the distribution of monastic granges in south-east Scotland is sufficient to suggest approximate levels of organised agriculture (Fig. 8.1). Several of these lie above the 300 m contour, in particular those attached to Soutra Hospital. Moreover, a comparison between Figures 8.1 and 9.9 illustrates that the granges of Mayshiel and Penshiel (GR 624641, 642632) and some of the lands of Coldingham Priory were located in regions which would have been distinctly unfavourable in the late nineteenth century. At Tollis Hill (GR 520580), which is recorded as a farmstead in 1252 (Graham, 1948-9), cultivation extended to 425 m O.D. at some point before the abandonment of the steading in the period 1600-1750.

Yet it is clear that, even near the summits of the Stow Uplands at elevations above 275 m O.D., there was pressure on unreclaimed land (supra p.203). It thus seems that regular cropping of cereals was practised at high levels in the twelfth and thirteenth centuries under little restraint from cold, wetness or exposure.

<u>The medieval deterioration</u>

Much of the subsequent abandonment of upland cultivation in the late Middle Ages has been attributed to social and political factors (supra p.211). Its distribution (Fig. 10.6), however, shows a remarkable coincidence with the upland zone which became sub-marginal owing to a deterioration of climate. Of the 600 ha of tillage which may have been permanently abandoned before 1600, at least 235 ha stood above the climatic limit to cultivation in 1530 and most of the remainder lay in the zone which became climatically marginal to the cultivation of cereals.

Moreover, of 15 steadings which were deserted at the same time, three were sited well above, and a further three close to the climatic limit to cultivation in the sixteenth century. Eight of the remainder lie on the moors of Quixwood and Coldingham which are likely to have become severely exposed to more frequent easterly gales in the fifteenth and sixteenth centuries. The size and morphology of these steadings suggest that they were the centres of established farms, not of temporary intakes by cottars; their dereliction is thus evidence of the retreat of long-established agriculture.

It is probable that much more farmland than is illustrated in Figure 10.6 reverted to moor in the late Middle Ages, but most was recovered before 1860. The balance which was never reclaimed may represent the response to a long-term increase in the disparity between potential for crop growth and the medieval limit of cultivation. Although a spatial correlation does not necessarily reflect an underlying causal one, the implication is that, while the Black Death, the decay of the monastic farming system or short-term climatic changes may have provided the immediate stimulus to abandonment, a slow deterioration of climate since the mid-thirteenth century had steadily reduced the potential for successful cereal cultivation in the marginal uplands. It made high-level agriculture and settlement particularly sensitive to any socio-economic or physical changes which touched upon their viability, and it may be argued that, had there not been this secular deterioration, the immediate stimuli might have promoted a less widespread and a less permanent response.

The seventeenth century nadir

Figure 10.7 illustrates the quantity and distribution of upland settlement at the time of the surveys of Pont and Gordon between 1583 and 1648. It is the most convenient indicator of the amount of existing farmland that may have become marginal or sub-marginal in the early seventeenth century. A comparison with Figure 10.8 indicates that of 15 steadings located above the climatic limit of 1530, three were abandoned before the time of the Military Survey. A further six disappeared from the fringe which became theoretically sub-marginal over the period 1530-1600, while only three marginal and no non-marginal steadings disappeared. Moreover, of 2,990 ha of cultivation which reverted to permanent moorland between 1600 and 1800 (supra Table 6.2), about three-quarters became climatically sub-marginal between 1400 and 1600. Almost all was marginal to cereal cropping in the seventeenth century.

It would be naive to suggest that the climatic deterioration was largely responsible for the quantity and the date of this abandonment, but the coincidence with a trend to increasing climatic sub-marginality cannot be ignored. Indeed it would be remarkable if the highest cultivation had not been abandoned: some farmland associated with settlement mapped by Pont in 1583-96 but abandoned soon afterwards would have tolerated in the seventeenth century an average probability of harvest failure as high as 0.4.

Climatic recovery and reclamation

It is evident that the improving movement was associated with a re-advance of cultivation and settlement in the late eighteenth century.

This represented a response to the increasing availability of capital and the rising price of cereals (infra p.357). Much of this extension included the secondary reclamation of reverted cultivation and the rebuilding of derelict steadings, but the zeal for improvement drove some land owners to reclaim virgin moorland and to establish new farms. There is no doubt that over this period the role of an ameliorating climate was reduced to a minor one by the strong socio-economic forces promoting investment in agriculture. But it is possible that the existence of derelict land at elevations which, in the late eighteenth century, were favoured by adequate summer warmth and dryness, encouraged reclamation. Much of the abandoned cultivation of the seventeenth century would no longer have been climatically sub-marginal, and would have attracted renewed cultivation.

The continued rise of critical levels of the climatic parameters up to the present is less significant, since upland farming rests now on the cultivation of sown grasses rather than of cereals. The demand for upland tillage is thus much reduced. It is evident, however, that all the areas of abandoned cultivation in the Lammermuirs lie below the average climatic limit to cereal cropping in 1910-60; and if climatic deterioration has been a significant factor in the early reversion of farmland, then it should be noted that the modern amelioration has removed a restraint to the re-intake of this abandoned land.

SHORT-TERM CHANGES OF CLIMATE

The foregoing discussion has focussed on secular changes in climate since it is believed that short-term changes alone cannot account for permanent reversion of cultivation. It has been noted, however, that periods of consecutively cold, wet summers were a threat to marginal farmers, and thus they warrant brief consideration.

It is evident that in the most isolated parishes of Aberdeenshire there occurred extensive abandonment of farmland after the sequence of poor summers, 1693-98 (Walton, 1952). Some farms remained in waste up to ten years later and the price of land did not recover its former level until after 1730. But Walton rejects the opinion of contemporary writers that famine had permanently extinguished farming activity over large areas. The glens of the Foudland Hills in western Aberdeenshire were the only lands to be deserted and never reclaimed.

This tends to support the assumption that short-term changes of climate operated only as the immediate stimuli to abandonment of land and were only effective in areas that had become sub-marginal to cultivation through long-term deterioration of climate. Yet as immediate stimuli they are likely to have been important for, because the coefficient of variation of summer warmth varies inversely with total summer warmth, the probability of 'runs' of poor years increases exponentially with long-term deterioration of climate.

It is therefore suggested that, if Lamb's estimates of a secular deterioration in climate are accepted, large areas of marginal cultivation became profoundly sub-marginal in the sixteenth and seventeenth centuries. Owing to an inertia, promoted by a lack of choice open to the subsistence farmer, this sub-marginal land may have continued in use until the occurrence of an overwhelming short-term stimulus for its abandonment. If the land had not become sub-marginal over the long-term and therefore sensitive to more immediate stimuli, it is argued that neither the scale of abandonment nor its permanence would have been so marked.

CONCLUSION

From this discussion the following conclusions may be drawn:

1. Pre-nineteenth century cultivation of cereals on marginal, maritime uplands was particularly sensitive to altitudinal or temporal changes in accumulated summer warmth, PWS and exposure.

2. When secular trends in temperature and rainfall are resolved i) into critical levels of warmth and PWS and ii) into the probability of crop failure, the theoretical limit to oats cropping falls over a vertical distance exceeding 140 m between 1300-1600.

3. Isoline movements by critical levels of warmth and PWS indicate a fringe of 'historically marginal' land where shifts by the limit of cultivation may have been greatest.

4. The temporal and spatial coincidence between these isolines and abandoned land suggest a causal relationship.

The suggestion is that the abandonment of high land, which was widespread in the late seventeenth and early eighteenth centuries in the Lammermuir Hills, was partly the product of a slow deterioration in potential for crop growth due to a trend toward colder and wetter summers.

CHAPTER 11

SOCIAL AND ECONOMIC DETERMINANTS OF THE MOVEMENT OF THE LIMIT OF CULTIVATION

While long-term changes in climate have often dictated the sensitivity of marginal agriculture to a short-term stimulus for abandonment or reclamation of land, there is no doubt that short-term forces, while not always providing an underlying explanation for movement of the limit of cultivation, were generally the prime determinants of its timing and its location.

In this chapter consideration is given to the economic, historical and social forces which were partially responsible for the retreat of cultivation in the late medieval period and the seventeenth century and for its later re-advance. Several political factors have been touched upon in Chapter 8, discussed in their chronological order as specific occurrences which were associated with the timing of change at the limit of cultivation. These will not be reconsidered in detail. Instead the discussion is focussed on the major socio-economic determinants of change and is organised in a systematic rather than chronological fashion. Emphasis is placed on those determinants which have been underestimated in previous studies and on those which specifically dictated the extent and direction of fluctuation of upland cultivation.

The factors influencing the uphill advance of cultivation are two-fold. First, it has been demonstrated that there exists an array of physiographic and climatic restraints on the cropping of cereals in upland areas, and that these restraints increase markedly with elevation. Secondly, it is clear that the need for an uphill advance of cultivation arose from a change either in demand for agricultural produce or in the nature of its production. Production could have been increased either by an expansion of the area of tillage or by an increase in productivity per hectare. Thus a rapid increase in productivity might have promoted the abandonment of marginal farmland while, conversely, growing demand accompanied by unchanging productivity might have encouraged expansion into regions that were previously unattractive.

It is therefore convenient to seek an explanation for changes in the location of the cultivation limit, first, in innovations in cereal cropping which mitigated the restraints of an upland relief and climate and, secondly, in changes in the balance between productivity and demand which determined the quantity of land that, ideally, would have been under cultivation.

In this chapter consideration is given to:

1. Change in technology and in farming practice, which altered the extent of cultivable land and its productivity;

2. Change in land ownership and land tenure, which enabled innovation in farming practice;

3. The commercial stimulus for change;

4. Change in accessibility of the uplands to inputs and to markets;

5. Population change.

CHANGE IN TECHNOLOGY

New crops

The return to seed in the Middle Ages was surprisingly low. Satisfactory data are not available for Scotland but for north-western Europe as a whole it has been estimated that the seed:yield ratio for oats averaged between 1:3 and 1:4 (Van Bath, 1963: 18). It may have been substantially lower in upland Scotland. The ratio may have increased slightly in the late medieval period, but in northern Great Britain it is likely to have remained largely unchanged until the early eighteenth century. One of the reasons for this was the lack of any substantial improvements in seed-corn. The first important development seems to have occurred after 1700 with the replacement of the 'black' by the 'common Scotch' oat (supra p.274), a strain which, under suitable conditions, gave a higher yield. One may suspect that this change was encouraged by the increasing commercialisation of upland cultivation.

By 1800, however, a number of new varieties of oat had been adopted. First, on the lower and more sheltered ground, high-yielding varieties such as Poland, Dutch and Potato oats, which ripened generally later than the common oat, were adopted by the majority of farmers. The new strains returned between four and twelve times the seed (Kerr, 1809: 244-5). Other things being equal, such increases in productivity might have promoted some abandonment of high-lying land and an intensification of production in the foothills. But more hardy strains became available at the same time. Red Oats had become popular on upland farms by the 1790s because they ripened earlier than the common oat, were reliable in uncertain summers, and were less liable to shaking than the new high-yielding varieties (OSA: XIII: 387; Farmer's Magazine, 1803). Where harvests were seldom completed before the end of September, a seed that ripened early was a great asset. Hence the reporter for the Board of Agriculture on the Lammermuir Hills commented that 'Red Oats are ... found to be the greatest acquisition hitherto known' (Lowe, 1794: 101). On average they yielded 31 bushels per acre (4.6 hl/ha) from a sowing of 6 bushels, a seed:yield ratio of over 1:5 (Lowe, 1794: 96; Kerr, 1809: 244).

The discovery of a strain which gave a greater return to seed on high lands than the 'common' or 'black' oat brought much of the periphery of the Lammermuirs within the zone of potential cereal cultivation. It was clearly an encouragement to the cropping of the uplands and enabled the high prices which oats commanded during the Napoleonic Wars to promote the reclamation of virgin moor. It would be safe to assume that the extent of upland 'catch-cropping' at this time would have been less widespread had farmers not expected a fair return to their seed. The adoption of Red Oats between 1780 and 1800 may thus be reckoned an important factor behind the upward advance of reclamation at the turn of the century.

But other crops, relatively new to the system of husbandry practised in south-east Scotland, also determined changes in location of cultivation. Turnips, which had been introduced to the region in the 1740s but not generally adopted by upland farmers until 1770-90 (Table 8.9), were more tolerant of cold and exposure than any crops previously available to the local farmer (Ventskevich, 1961: 115). Moreover there were large areas of well-drained soil that, if heavily limed, were well suited to turnips which provided a convenient preparation of moorland for barley or oats, particularly when fed on the field to sheep (Naismyth, 1796; Kerr, 1809: 277). Much of the study area, which was unsuited to cereals, thus became attractive to tillage, and became increasingly so after 1780 with the rise in price of cattle and sheep for which turnips were a valuable source of winter feed. The result was widespread reclamation of moorland. In 1829 Robertson noted of the uplands throughout the Lothians that, following the adopting of turnip husbandry,

> Many thousands of acres in these remote places, which formerly produced hardly an article of food for man or beast, now yield as much, or more, than the infield lands of former times. The wild outcry against the cultivation of such barren lands, as our half-witted political economists are continually making, shews that they know nothing at all about the matter.
>
> (Robertson, 1829: 333)

Indeed, throughout the parish reports in the Statistical Account there is mention of the intake of high land for turnips. The account for the parish of Cranshaws, the most remote in the study area and where the previous three centuries had been characterised by land abandonment, may be taken as an example

> The soil, being light and dry, is suitable for raising turnips and sown grass. Of late farmers have availed themselves of the advantages arising from this kind of soil, and have already carried this species of improvement to a considerable height.
>
> (OSA: VI: 438)

As this reference suggests, the introduction of sown grasses in the same period and for the same purpose compounded the incentive for upland reclamation in the late eighteenth century (OSA: II: 355; XIII: 386). At Cockburnspath it was reported in 1795 that

> Great tracts of land, which formerly were covered with heath, or over-run with furze, [are] being brought to a set of excellent breeding farms, a great part of which is kept in pasture.
>
> (OSA: XIII: 233)

The suggestion is, then, that the introduction of crops more suited to the climate and relief of the uplands brought large areas of high-lying moorland within the zone of cultivable land. The potential limit of cultivation was thus pushed beyond its traditional margins. The economic incentives which spurred their introduction and encouraged the realisation of this new potential will be discussed later.

New rotations

Increases in productivity were due as much to the systems under which the crops were worked as to the crops themselves. Before 1750 the infield-outfield system was characteristic of agriculture in the foothills and uplands of the study area (supra p.28). The pattern of husbandry was oriented toward the extensive use of land, with few inputs and low yields.

By the 1770s, however, the bare fallow, which had been promoted by Hamilton (1713: 7) more than seventy years before, was widely used. In the foothill zone of the study area a common rotation was five-fold: fallow-barley-oats-peas-bere. But the division between infield and outfield was still evident and on improved outfield barley and oats were sown alternately (Farmer's Magazine, 1811: 204).

The great increase in productivity came with the adoption of rotations that incorporated grasses, root crops and new legumes, and which were particularly suited to high lands and to improving moorland soils. A selection is summarised below:

> fallow (+ dung, lime) - turnips - oats or barley - oats or barley - clover + rye grass (Naismyth, 1796)
>
> turnips (+ dung) - oats or barley - clover - oats (Lowe, 1794: 101)
>
> oats or fallow or turnips - oats or barley - clover and rye grass (Kerr, 1809: 347)

Much depended on heavy liming and on a good second season for the crop of oats or barley to recoup the costs of breaking in the new ground, but yields were almost double those obtained under the outfield system (Farmer's Magazine, 1811). If such increases in productivity were achieved in this short time, the abandonment of arable over 1770-1790 might be explained by the intensification of cropping and insufficient growth of demand. Thereafter, the burgeoning of demand in wartime exceeded increases in productivity and encouraged an extension of tillage. Had such changes to cropping systems not occurred in the pre-war period, however, and had productivity not so increased, the reclamation of moorland in the wars would have been more widespread.

New livestock

The reclamation of moor for turnips and sown grasses was motivated by the high prices of wool and mutton at the turn of the century (infra p.370). Lowland and foothill farmers had for some time been experimenting with Cheviot and Leicester sheep, and with the rapid rise in prices in the 1780s the difference in profits to be made from the new breeds, rather than from the traditional Blackface, widened (Naismyth, 1795, 1796; Young, 1793; Fairbairn, 1823). The Cheviot fleece fetched two or three times that of the Blackface, and Cheviot wethers averaged 30 per cent more at the spring sales (T.H.A.S., 1955). By the 1790s, therefore, the Cheviot breed was well-established in even the remote parishes of the study area (OSA: XIII: 386).

Yet the new breeds were less hardy than the Blackface, requiring more fodder to carry them through the winter to the first bite of spring grass. Since the onset of the growing season is quite long delayed at elevations exceeding 200 m in south-east Scotland the quantity of turnips and grass that thus needed to be grown, especially on the higher farms, was considerable; and whereas little or no arable land had been traditionally devoted to feeding the Blackface, much of the high moors in the Lammermuirs were reclaimed specifically as feeding grounds for Cheviot breeding stock. Hence the advance of cultivation was, at least in part, a response to the requirements of new breeds of sheep.

New husbandry

Technological change in the protection of crops and control of stock movement, in drainage, fertilizers, implements and the provision of shelter also contributed to movements of the limit of cultivation. Many of these innovations were adopted some time after their appearance in England, where their impact on farming systems is well documented. For this reason a discussion of their characteristics will be restricted to their role in promoting the abandonment or reclamation of land.

Enclosure

The progress of enclosure in south-east Scotland can be traced from estate plans, from contemporary descriptive and advisory publications and from reports in the Statistical Account and New Statistical Account. From a study of these sources it is evident that enclosure of arable land on the farm scale did not occur in East Lothian until about 1720 (Somerville, 1805: 82). But the commercialisation of agriculture, encouraged by the rising price of grain from about 1750, ensured that one-half of the county was enclosed by about 1780 (Farmer's Magazine, 1811). Through the 1780s and 1790s enclosure made rapid progress in the foothills and uplands, but it is clear that the movement was still important in these areas after 1810 and, indeed, that large areas of upland arable were never enclosed at all.

It is important to understand, therefore, that perhaps thirty years separated the peak of the enclosure movement in the lowlands from that in more remote areas. A similar lapse in time occurred between upland and lowland in central Ayrshire (Lebon, 1946b).

Thus the arrival of war-time prices found most of the high arable land open and unimproved, and much of the energy that might have been devoted to the enclosure of newly reclaimed land was devoted to enclosing old arable. Moreover the sheep moors, although they had long been held in severalty, had few dykes to control the movements of flocks (Kerr, 1809: 346); and the cost of breaking up and liming the new ground, compounded by the uncertainty both of continuing high prices and of the oats harvest which would recoup the investment in reclamation, prohibited further outlay on enclosure (Farmer's Magazine, 1803). This acted as a deterrent to reclamation at the end of the eighteenth century.

> There is a great quantity of the lands in the upper district [the Lammermuir Hills] very fit for turnips, but they are not much cultivated, unless where the land is enclosed, or lies detached from the sheep-walk or pasture. A field of turnips on an open farm, in the moor lands, is considered as a great hurt to the breeding stock of sheep on it. They must be kept at such a distance from the turnip field as to lose the benefit of pasturing around it, during the winter, to a considerable extent; and this does the stock more hurt than the turnip field can make up.
>
> (Lowe, 1794: 32)

This may explain the tardiness with which reclamation responded to rising prices in the 1780s. It was not until the late 1790s that the prices of both grain and livestock fully overcame objections to the intake and cropping of open land; and even then the reclamation which followed was envisaged only as a short-term investment because few of the intakes were enclosed. Consequently, when profits shrank after 1815, the new lands were soon abandoned. Indeed, none of the land abandoned in the study area before 1860 exhibits signs of enclosure: it seems that the lack of fixed investment in stone dykes contributed to a lack of momentum in improvement. Thus the scarcity of enclosure in the uplands not only retarded the advance of cultivation but ensured that much of it was temporary.

Similar forces operated to less effect over 1850-80, unenclosed intakes soon reverting to moor after the fall of prices over 1876-80. Yet, since the mid-century rise in price of livestock was proportionately higher than that of cereals (infra p.372), reclamation at this time was more particularly directed to the provision of improved pastures for sheep flocks, and the intakes were consequently more frequently enclosed. During the following depression enclosed pastures, however remote, tended to be put down to permanent grass and regular grazing ensured that many did not revert to moor. For this reason, amongst others, the retreat of improved land in the 1880s was less marked than that of the 1820s.

Drainage

It was concluded in Chapter 6 that most cultivation ridges had been levelled and straightened in the lowlands by 1780 and in the uplands before 1810. In the foothills the decade 1790-1800 represented the period of most rapid change. Moreover, it is evident that these adaptations to the cultivation ridge resulted in a halving of the average ridge: furrow ratio and thus a halving of the land wasted in the furrows (Fig. 6.3). Even if it is assumed that the median line of cultivation ridges tends to over-estimate the width of furrows (supra p.140) it is probable that, under the traditional system of husbandry, the furrows comprised up to one-quarter of the ploughed area. It may therefore be supposed that the levelling and straightening of ridges led to an increase in the productive proportion of the ploughed area from 75 per cent to about 85 per cent. This corresponds to an increase of 13 per cent in the total productive area.

It should be emphasised that this is an estimate of average conditions and that there would have been large variations in the change. It does suggest, however, that production from arable land may have increased by more than one-tenth in the late eighteenth century due to improvements in drainage alone. In satisfying some of the increased demand for cereals during the Napoleonic wars this development may have reduced the expansion of tillage that would otherwise have occurred over the period 1790-1815.

It has been suggested in Chapters 6 and 8 that tile drainage did not become widespread in south-east Scotland until the mid-1850s. In the 25 years that followed, however, the fact that it was available represented a major incentive to large-scale reclamation in the study area. Its advantages to agriculture were numerous. Soils could be work more easily, requiring less labour and reducing production costs. Crops ripened earlier and offered increased yields of better quality. These benefits were recognised by farmers who were anxious to take advantage of high prices, especially of livestock, between 1860 and 1880. The contemporary literature is scattered with references to the importance of tile drainage in the advance of cultivation in mid-century (Skirving, 1873: 26; Sanderson, 1863: 361-2).

> The foundation of all improvement in the Scotch farming is the system of <u>thorough draining</u>; and so essential is this considered, that most of the land is deemed unworthy of being farmed at all, until it has undergone this operation.
> (Greg, 1842: 22)

This belief was evidently reflected in the demand for the new drains: it has been noted that 18 tile works had been established in East Lothian and Berwickshire by 1860 (supra p.134).

Tile drainage determined not only the quantity but the location of the new intakes. Without it reclamation would have been limited to dry, rounded slopes such as those common in the eastern Lammermuirs, but its availability ensured that less well-drained areas could be made to carry turnips and might therefore be profitably reclaimed (Gibb, 1921).

It is also likely to have influenced the quantity and location of land that reverted after 1880. The cost in 1872 of breaking up 1 ha of clay moorland by steam engine and Sutherland plough, followed by further ploughing, liming and harrowing, averaged £27 (Gibb, 1921). This investment would not be discarded lightly when times became harder, and little of the drained land was therefore abandoned in the 1880s. Most of the reversion was of light soils that had been abandoned in the 1820s and taken in once again with little expense in the 1850s. In these areas the improved cultivation ridge offered sufficient drainage for turnips. The presence of tile drainage thus influenced both the location and the timing of movements by the limit of cultivation.

Fertilizers

It has been suggested that the introduction of lime encouraged the extension of cultivation in the early seventeenth century, and that its increasing availability after 1760 turned the attention of foothill farmers to potential arable land in the uplands (supra p.239). The crops taken from limed outfields, particularly from those which had not been previously limed (Farmer's Magazine, 1811), showed that much of the virgin moor in the Lammermuirs could be made to bear oats and turnips, and in the years of reclamation from 1790 to 1816 lime under-pinned the hopes of a good return on capital invested in new land. It was reckoned that much of the lower Lammermuirs could be converted from heather moor to pasture by enclosure, fallowing and liming (Lowe, 1794: 79).

Indeed, not one reference has come to light in contemporary manuscripts or publications of primary reclamation being effected after 1790 without the aid of lime or marl.

The quantity of lime required on outfield was 50-60 bolls per Scots acre (7.3-8.4 hl/ha) although this might be reduced for land that had never been ploughed to 15-16 bolls (2.2-2.3 hl/ha) (Hepburn, 1794: 85). But while the price of lime at the kiln was 1s 3d to 2s 11d per boll in 1805 (Skinner, 1969: 27), the cost of carriage over 10 km might equal this, so that the final cost of liming a Scots acre of outfield might be £6-£10 and of new arable about £1 10s - £2 10s.

Since the cost of carriage doubled the price of lime every 10 km from the kiln, proximity and access to the kiln were major factors in determining whether liming - and hence the reclamation of moor - was worthwhile. The nearest kilns to the Lammermuirs in the late eighteenth century lay in the northern parishes of Innerwick, Humbie and Yester. There may have been a kiln at Coldingham, but this was probably the only one in Berwickshire (Skinner, 1969: 37-42, 13). Thus in the south, at Greenlaw and Westruther, farmers had to pay for carriage up to 34 km. The only alternative was to buy imported lime at Eyemouth or Cove which were almost as distant, or to carry it from Northumberland through Coldstream. There were deposits of shell marl along the banks of the Whiteadder but the quantities required were much larger than for lime and, although the effects of marling were more lasting, farmers were looking more to the short- than the long-term in profits from reclaimed moorland (OSA: III: 156).

The greatest distance for which the carriage of lime was worthwhile in the 1790s seems to have been about 20-30 km (Lowe, 1794: 34, 97). This increased with the improvement of roads in the 1800s but it still ensured that over much of the southern moors the return to liming was marginal. Indeed, it is likely that the lack of reclamation in Greenlaw and Duns over 1790-1815, on lands that lie below 230 m and are freely drained, can be attributed largely to the cost of lime. This is in contrast to the widespread intake of land in the north-east of the study area which lay near to large kilns on the coast at Skateraw and Catcraig.

Moreover, it seems that liming also influenced the abandonment of upland arable. Its expense might not so swiftly be defrayed by the cultivation of fodder crops or by the sale of lambs and wool as by cereals. Lowe (1794: 97) reports one case of a single crop of oats returning the outlay on carriage of lime over 24 km. But if profits were to be made from the new land the temptation was to sow successive white crops, and the consequent exhaustion of moorland soils was commonplace (OSA: VI: 135-6, 439-440). In his report on the estate of Marchmont, Low noted that this occasioned the rapid reversion of arable once the price of grain had collapsed (GD 158/20: 59). It seems that over-cropping of the intakes had reduced yields to a point where tillage of any kind was worth sustaining only at times of exceptionally high prices.

New implements

It has been suggested that the adoption of the swing-plough opened the way to the levelling and straightening of ridges and thus led, indirectly, to an increase in productivity. Moreover it is evident that, since the new plough was lighter and required fewer draught animals, it dispensed with the need for a driver. It was now possible for one man and two horses to do the work that had traditionally required four men and eight to twelve oxen (Sinclair, 1814: IV: 356). This not only increased the productivity of labour but released arable land from fodder to cash cropping. The consequent increase in output from a smaller area under tillage may be one explanation of the contraction of arable in periods of static demand.

At the same time as the introduction of the swing-plough, similar progress was achieved in the improvement of other implements, encouraged by the rising cost of labour. These often represented the belated adoption of machinery introduced to England in the third quarter of the eighteenth century and as such are well documented by English economic historians (Chambers and Mingay, 1966: 69-71). But two deserve specific mention in the Scottish context. An important advance was the introduction of drilling instead of broadcasting, which wasted a proportion of the seed in the furrows. While, in 1778, it was reckoned that there were not twenty drills in East Lothian, by 1810 almost every farmer used one, with consequent increases to the seed:yield ratio and to the productivity of labour (Farmer's Magazine, 1811: 517). Even greater savings in labour were made by the use of a threshing machine perfected by Andrew Meikle in 1787. It is suggested that the decline in demand for seasonal labour consequent on the adoption of such machinery contributed to the fall in farm population and the eviction of cottars, trends linked in turn with the contraction of upland tillage in the late eighteenth century.

The provision of shelter

It is evident that there exists a close causal relationship in upland south-east Scotland between the limit of cereal cultivation and levels of exposure, which vary almost linearly with elevation. It has been suggested, therefore, that the planting of shelter-belts in the late eighteenth and mid-nineteenth centuries was an important inducement to the uphill extension of cultivation (supra p.279). This created field climates more suitable to oats and barley, both of which are susceptible to wind damage (Gloyne, 1954).

The landowners in the region were quick to realise the value of shelter-belts, and the gradual provision of shelter can be detected from the appearance of plantations on the series of county maps. Planting seems to have been particularly common in the foothills from about 1780-1820, but little was attempted on the uplands themselves until the 1850s. Lowe (1794: 51) complained that while 'planting would be of greatest utility to Lammermoor, by giving shelter to the cold bleak hills' the farmers found difficulty in establishing young trees. In the middle of the century, however, the need for shelter of stock and for provision of an early bite of grass renewed attempts to plant on the hills. A few were successful. 'The results of recent operations on the farm at Elmford [Ellemford] are ample proofs of the capabilities of the district' (Sanderson, 1863: 371). The present owner of Ellemford in Cranshaws has concluded that over the past seventy years one-third of the increase in value of the property is due to improved shelter, the remainder to general technical improvements in agriculture (Landale, 1960-1). In select areas such as this, where there was a policy of planting in the nineteenth century, the provision of shelter undoubtedly encouraged high-level arable and insured against abandonment. Unlike other newly reclaimed land in the study area, there is little evidence for the reversion of sheltered intakes in the 1880s.

Conclusion

While some of these technical improvements to agriculture, particularly liming and tile drainage, were in themselves important determinants of changes in location of the cultivation limit, the combined influence of all these developments had a more profound effect; their synthesis is reflected, first, in gradual change to the farming system operating in the study area and, secondly, in major increases in yield per acre of crops and livestock.

Reference has been made to the change from an integrated system of arable and pastoral farming in the medieval period to a more segregated economy in the sixteenth and seventeenth centuries. Cultivation became oriented more to subsistence than to livestock or to lowland demand, but the range of crops and the technology of crop husbandry remained as limited as it had been two centuries earlier. There is, indeed, evidence of a lack of innovation in Scotland from the fourteenth to the early seventeenth centuries similar to that in late medieval England (Fussell, 1968). The only major technological change appears to have been the introduction of liming and marling which increased yields on lower lands and, in the face of static demand and an increasingly severe climate, may have contributed to the abandonment of remote arable land. Yet, with about one-quarter of the ploughed land unproductive and only intermittent cultivation under the outfield system, tillage remained an extensive operation and the elevation reached by cultivation in response to this system could not be substantially reduced.

The period of innovation from 1760-1800 released tillage from these constraints. Cultivation was now perennial throughout the farm rather than on the infield alone, thus the area under tillage, which had traditionally been only two-thirds of the farm at any one time (the infield and one-half of the outfield), was now increased by 50 per cent.

At the same time arable husbandry became more intensive and was more closely integrated with livestock feeding. Both this and the introduction of a market-oriented economy encouraged the development of larger, more efficient farms (infra pp.360-64).

More efficient production was reflected in improved returns to seed. By the 1790s the seed:yield ratio of oats, which in the Middle Ages may have averaged 1:3 in the study area, had increased to over 1:5. By 1820, after the contraction onto the best land, it may have been 1:7, and over 1895-1914 it has been estimated for lowland areas at 1:8.6 (Van Bath, 1963: 173).

It is thus possible to account for increases in production by a number of factors: at least 13 per cent of the increase was due to the levelling of cultivation ridges, probably about 50 per cent to the move to perennial cultivation, and possibly a further 40 per cent to increases in return to seed. The suggestion is, therefore, that production from farmland doubled in the south-east of Scotland between 1760 and 1820.

This confirms the estimate by a contemporary observer that from 1765 to 1827

> ... the quantity of corn and other vegetables has been doubled, whilst that of animal food has been increased to six times the former extent.
>
> (Robertson, 1829: 383)

Evidence for an increase in production is supported by signs of a swift rise in the value of land. More detailed consideration is given later to this trend but it may suffice for the moment to note that the average levels of real rent for land in East Lothian tripled over the period 1778-1810. It might be contested that these increases reflected more the rise in prices and the value of produce than increase in productivity. This was not, however, the opinion of contemporary writers who attributed them to the 'increased quantity of produce, arising from superior cultivation' (Farmer's Magazine, 1811: 521; also OSA: XIV: 503-4; NSA: II: 105).

The contrast in productivity between the traditional and new systems goes some way to explain two observations. First, productivity per hectare under the traditional system may partly account for such extensive cultivation in the early medieval period, an extent which seems at first to be disproportionate to contemporary demand. Secondly, substantial increases in productivity may account for the contraction of tillage in the 1780s. It seems that not until 1790 did the intensification of production fail to keep pace with demand and thus that farmers were again encouraged to extend their arable acreage.

There is also the suggestion that increasing productivity was a major cause of the abandonment of the most remote arable land over the period 1760-90. Its influence is apparent, though less marked, in the seventeenth century and over 1820-30 and 1880-1900, but was masked by increased demand between 1790 and 1815. There is the implication, however, that the Napoleonic advance of cultivation would have been greater if some innovations had been delayed and if tillage had remained as extensive an operation as it traditionally had been.

CHANGE IN INSTITUTIONAL STRUCTURES

Such changes in technology as occurred between 1600-1900, but which were particularly apparent in the century 1750-1850, were made possible by changes to the patterns of land ownership and land tenure which increased the amount of capital available for agricultural improvement, encouraged more efficient management of farms and estates and, in some instances, led to the contraction of tillage through increases in farm size.

Change in land ownership

The extension of monastic lands in the twelfth and thirteenth centuries was encouraged by the rapid expansion of the wool trade, and it seems that both religious and lay interests were competing for rights to hill-pasture in order to increase their stock (Barrow, 1962). Over large areas the abbeys succeeded in monopolising the ancient shielings and were able to develop an integrated system of lowland grain and upland stock farming. The high-level granges could rely on capital from the abbey's coffers and on a sure outlet for their produce. This availability of capital and reliability of markets gave monastic farming a substantial advantage over its secular counterparts.

The gradual alienation of monastic lands in the sixteenth century removed these benefits and it may be conjectured that this development underlay the abandonment of remote settlement and land in the following era. The large capitalist tenant farmer, who was later to ring most of the changes in agriculture, did not emerge from the farming peasantry until about 1760, and the landowner up to this time could be the only agent of technical innovation (Smout, 1964). Yet with the poorly-developed commercial economy and the frequency of feuding up to 1660, the landowner was generally satisfied simply to protect his interests rather than to extend them. The number of men on his estate was more important than the level of rent, and holdings were sometimes split to accommodate as many tenants as possible (Smout, 1969: 140-1). Moreover, a law of entail, designed to prevent the alienation of land from a family line, forbade until 1770 the contraction of debts and thus effectively limited the credit available for improvements. Until the mid-eighteenth century, then, there was little encouragement from landowners to improve agriculture. The implication is that limits of cultivation fell less than they might otherwise have done in response to a deteriorating climate and only slow growth of demand.

After about 1750, however, there was increasing change in the structure of land ownership. Merchants, lawyers and manufacturers were keen to grasp the prestige and security of investment that ownership of land offered, and they bought land where they could. Its proximity to the cultural capital made the south-east particularly attractive, and Smout (1969: 283) notes that about two-thirds of the land in Roxburghshire changed hands between 1750 and 1815. In 1792 the incumbent of Stow recorded that three-quarters of the property in the parish had been bought and sold over the previous 45 years (OSA: VI: 133).

This trend had two important consequences for the extent of cultivation in the region. First, it brought large quantities of capital - often fortunes made in the East and West Indies - into the agricultural economy, and this new resource was applied with an enthusiasm for improvement motivated as often as not by high ideals. Such investment was of especial value for it was lavish and long-term, aimed at establishing reputations rather than winning fortunes (Smout, 1964). A similar, though perhaps more commercial, trend was evident in England at the same time and its significance to improvement in agriculture is well documented (Jones, 1967: 28-29). In the south of Britain its role may have been overemphasised (Thompson, 1969), but in Scotland, where chronic shortage of capital was characteristic before the creation of links with industry and trade, this is less likely. The importance of the new 'improving' lairds to the agricultural revolution in Scotland has been discussed fully by Handley (1963: 73-89) and need not be reiterated here.

A second consequence of the change in land ownership was a steady decrease in the size of estates in the study area. The number of discrete units of land ownership can be calculated for 1771-72 from the Inventory of Records of the Presenter of Signatures' Office (SRO, Exchequer Series, E.901) and for 1895 from parish summaries of M.A.F.F. agricultural returns. Moreover, farm boundaries were surveyed by officers of the Department of Agriculture and Fisheries for Scotland in 1947 and are available in manuscript at a scale of 1:10,560. A comparison of these with valuation rolls for the same year enables the construction of a map of estates. Estimates for 1791-98 and 1834 may be made from incomplete figures in the old and New Statistical Accounts of Scotland. A summary of these figures is presented in Table 11.1. It is evident that there has been a continuous splintering of estates in the study area since the mid-eighteenth century and, whereas about 90 per cent of the region was contained in 25 estates in the early seventeenth century, these numbered 107 by the 1770s. They had increased by 50 per cent in the next century and had doubled by 1947. This fragmentation of estates, especially over the fifty years before 1815, seems to have been common elsewhere in Scotland (Smout, 1969: 285).

The pattern of land ownership existing in 1947 is illustrated in Figure 11.1. It is presented without reference points and at a reduced scale to conform to restrictions on publication required by the Department of Agriculture and Fisheries for Scotland. This map, and that of the pattern of holdings (Fig. 11.2), provided the base for reconstruction of those patterns extant in the eighteenth century from which links between farm steadings and farm land could be interpreted (supra p.178). The aim was to ensure the accurate dating of reclamation and abandonment of land from the establishment and desertion of steadings. The location of estate and farm boundaries was interpolated, in turn, from the 1947 base for 1895 and 1870, by reference to data in the agricultural returns and valuation rolls; for 1834 and 1790-98, by reference to the Statistical Accounts, and for 1771-72 from the exchequer rolls. The use of this methodology in dating movements of the cultivation limit has been described in Chapter 7.

Table 11.1

Numbers of farms and estates in south-east Scotland, 1600-1947

(excluding parishes: Fala and Soutra, Stow, Crichton, Melrose)

	farms	estates
1947	483[1]	231[2]
1900	576	ND
1895	610	152
1890	637	ND
1880	665	ND
1870	678	c.140[5]

estimates from:

	no. of abandoned steadings[4]	estate rentals[3]	
1860	720	(720)	ND
1834	ND	ND	c.134[6]
1820	790+	790+	ND
1791-8	840+	ND	c.120[7]
1771-2	910+	ND	107[8]
1750	930+	990-1050	ND
1600	990+	ND	ND

sources:
1. D.A.F.S.
2. D.A.F.S. and valuation rolls
3. for estates of Marchmont, Innerwick and Dunglass
4. aerial photographs, county maps and miscellaneous charters
5. valuation rolls
6. NSA (1845)
7. OSA (1791-99)
8. exchequer rolls
remainder: M.A.F.F. agricultural returns

Figure 11.1 shows that most of the fragmentation of estates has occurred on the foothill and lowland fringe of the region, much of the western uplands remaining consolidated in the estates of Lauder, Roxburghe and Tweeddale. In the east, however, fragmentation is more evident and is the product of the reorganisation of estates following divisions of commonty. In the foothills the diminution of estates and increasing incidence of owner-occupancy led to greater attention to estate management and to both more intensive and more market-oriented farming. The result was the intake of low lying moors and the amalgamation of farms into more efficient units. In contrast the survival of larger estates in the hills encouraged a trend to more extensive livestock farming with little cultivation, the young stock or less hardy breeds being sent to lower farms on the same estate or being provided with fodder from the lowlands. Farm linkage was not a new feature in south-east Scotland: it has been noted as an important part of the monastic farming system. But its survival on the large estate may have helped to counter any pressure for abandonment of upland farms. In its modern form, linkage between separate farms under one owner but not part of a contiguous estate seems to have developed in the mid-nineteenth century when the high price of stock drew attention to more efficient sheep farming.

Change in size of farm

It was suggested in Chapter 7 that the creation of new farms and the amalgamation of existing ones were major causes of the reclamation and abandonment of arable land. Twenty-two farms established between 1750 and 1860 were associated with reclamation within the moorland core, and the sites of 35 steadings, 13 per cent of the total abandoned over 1600-1860, have been positively linked with the permanent abandonment of cultivation.

The study of estate rentals indicates that on the estate of Marchmont 22 farms, 32 per cent of the total in 1764, disappeared through amalgamation between 1764 and 1819. At Innerwick and Dunglass respectively 38 and 54 per cent of the farms were amalgamated over 1750-1820.

If the trend on these estates was typical of the area as a whole, then it might be concluded that one-third to one-half of the farms in the region disappeared in the late eighteenth and early nineteenth centuries. A higher figure of two-thirds over 1770-90 is quoted by some contemporary published sources (supra p.250) but this is likely to have been singled out for those parishes most affected by amalgamation; and since an average figure would include numerous small-holdings around the towns of Duns, Greenlaw and Lauder that would have been less subject to amalgamation, a reasonable estimate for the region as a whole is one-quarter to one-third. It is quite clear, however, that in selected areas the average size of farms increased by 50 to 70 per cent over 1750-1820.

Table 11.1 illustrates changes in the total number of farms from 1600 to 1947. Figures for 1870 to 1900 have been abstracted from agricultural returns, and separate estimates for 1600 to 1850 are drawn, first, from the number of abandoned steadings located from aerial photographs, county maps and miscellaneous charters and, secondly, from the number of farms disappearing from estate rentals. The conclusion is that the number of farms fell from about 1,000 in the seventeenth century to about

840 by 1800 (a decline of 16 per cent), 720 by 1850 (14 per cent) and 580 by 1900 (19 per cent). Between 1770 and 1850, the period of most amalgamation, the average size of farms increased by 21 per cent. The decrease in intensity of cultivation and abandonment of peripheral tillage consequent on such a trend have been discussed in Chapter 7.

It is evident from Figure 11.2 that amalgamation was more common in the uplands and foothills than the lowlands for there was a marked contrast in size of farm between these areas in 1947. The upland farms had, of course, always been larger than those below but they had not generally exceeded 500 acres and were not more than four times the average size of farm in the region (Farmer's Magazine, 1811; GD 158/20). Yet by 1947 the upland farms were often ten times the average size of farm throughout the study area. This amalgamation, amongst other factors, was a cause of widespread abandonment of arable in the upper valleys, in contrast to the continued advance of improved land into the outliers of lower moor.

One reason for amalgamation in the uplands was the introduction of sown grass and the trend to stock farming on foothill farms that had been traditionally oriented toward tillage. To be profitable the new stock farms had to be larger and it is evident that, at least on the estate of Marchmont, amalgamation was an explicit response to this requirement (Kames, 1776: 269; GD 158/20: 176). In addition to the obvious economies of scale accruing to the larger farm, more general reasons for increase in size included the landlords' preference, first, for tenants with both capital and the desire to improve their land and, secondly, for fewer farms which reduced the expense of estate management (Lowe, 1794: 12).

It may be concluded that two contemporaneous trends, the fragmentation of estates and the amalgamation of holdings, contributed to the extent and direction of movements of the cultivation limit in the eighteenth and nineteenth centuries. Moreover, the spatial pattern of these movements seems to have been dictated by the tendency both for fragmentation of estates to be most widespread in the lowlands and for amalgamation of farms to be most evident in the uplands and foothills. This encouraged the contraction of tillage on the remote, monastic intakes and the reclamation of new land from lower moor.

Divisions of commonty

It is evident from the discussion in Chapter 8 that a major reorganisation of farms often followed divisions of commonty, and that the consequent abandonment or intake of land was of sufficient scale to effect a change in the synoptic pattern of the cultivation limit. The wider implications of divisions of commonty for agriculture have been considered by Adams (1967).

A list of commonties in south-east Scotland, with their areas and dates of division, is presented in Table 11.2. It is evident that, before their division, 17 commonties comprised about 8 per cent of the study area and almost one-sixth of the moorland existing in 1800. All but 6 per cent of this land is now held in severalty, the bulk of it having been distributed over the period 1769-1842. Almost one-half of the land was reclaimed at some time after division, the date of division thus playing a major role in the chronology of intake.

Table 11.2

Divisions and reclamation of commonties

no. on Fig. 11.3, and name	parish	date of division	area(ha)	area (ha) reclaimed after division
1. *Westruther	Westruther	1713	(c.100)	(c.100)
2. Carfrae	Lauder	1769	(c.190)	42
3. Wideopen	Lauder	1769	759	759
4. Coldingham Moor	Coldingham	1776	2508	1645
5. Innerwick	Innerwick	1783	928	290
6. Duns	Duns, Langton	1786	634	435
7. Chirnside	Cockburnspath Abbey St Bathans	1805	996	640
8. Dunbar	Spott, Stenton Whittingehame	1833	1779	228
9. Oldhamstocks	Oldhamstocks	1836	456	132
10. Ewieside	Cockburnspath	c.1821	102	55
11. King's Inch	Channelkirk	1871	7	0

sources: Adams (1971)

*Dodgshon (1969)

Table 11.2 (contd)

no. on Fig. 11.3, and name	parish	date of division	area (ha)	area (ha) reclaimed
Date of division uncertain:				
12. Greenlaw Moor + Dogden Moss	Greenlaw	c.1842	1173	64
13. Polwarth Moor	Polwarth	c.1842	352	29
14. [1]Evelaw, Rawburn + Bedshiel	Westruther, Greenlaw + Longformacus	post-1825	(c.70)	0
15. [2]Housebyre	Melrose	post-1549	(c.50)	(c.50)
Not divided:				
16. Gifford	Yester		24	
17. Lauder	Lauder		702	
		TOTAL	10831	4467

sources: Adams (1971)

*Dodgshon (1969)

[1]Marchmont Ho., Blackadder, J., Plans ... of the estate of Marchmont, 1825

[2]GD 32/22/2

Furthermore, the locations of the commonties determined, in part, the pattern of intake. Figure 11.3 illustrates that seven of the commonties were clustered in the eastern Lammermuirs and were especially widespread between the parishes of Stenton and Coldingham. They presented a major restraint to the advance of cultivation before the 1830s and accounted for the broad expanse of moor in this sector. Conversely, their division and the consequent release of land for improvement contributed to the widespread intake of land at Cockburnspath and Coldingham in the period 1770-1860 (Figs. 7.19, 7.21, 7.23).

COMMERCIAL STIMULUS FOR CHANGE

Innovation in technology, amalagamation of farms and divisions of commonty were largely inspired by fluctuations in the profits to be made from upland cultivation, profits which were determined by the ratio of production costs to the market price of produce. In the following section consideration is given to the roles of the prices of grain and livestock in promoting changes in the upper limit of cultivation.

The move to commercial agriculture

It is clear that the influence of market prices on agriculture is determined in part by the extent to which the system of farming is oriented to a subsistence or a commercial economy. Prior to the seventeenth century most of the upland in the study area was farmed at a subsistence level. There is the suggestion of a trend to commercial farming in the 1620s and 1630s (Smout and Fenton, 1965), but at the end of the century between 70 and 90 per cent of estate rentals were still being paid in kind.

The pattern seems to change, however, in the following decades. Evidence for the estates of Innerwick, Cockburnspath and Belton indicate the commutation to money rents between about 1710 and 1770. In general, it seems that by 1740 about one-third of the rentals were paid in cash and that by 1770 most upland farms were paying a full money rent (GD 6/1703, 1709, 1712, 1717/1, 1727, 1762, 1742, 1755; GD 206/2/7/171/1-5; GD 73/1/11). Similar changes occurred slightly later elsewhere in southern Scotland (Handley, 1963: 53).

By the mid-eighteenth century, therefore, the limit of cultivation was likely to respond more closely to fluctuating prices than it had in previous centuries.

Change in prices

Sources

Price series of market crops are particularly comprehensive for Scotland both in their geographical coverage and chronological range. These derive from the 'fiars prices' struck annually at Candlemas by the sheriff courts as a basis for settlement of various fixed payments such as feu duties and rents. They were based on the average prices of the previous crop and are considered to be a satisfactory, though not exact, mirror of market value (Mitchison, 1965). They are certainly better than any price series so far advanced for England.

Fiars prices were struck for Lammermuir oats and bere, which were generally lower than those for Berwickshire and Haddington, but those published cover only the period 1689-1808 (Kerr, 1809: 7-18). The series for Haddington is available from 1627 and exhibits similar trends to those evident in the Lammermuir fiars. The price of Haddington oats is illustrated for 1643-1900, expressed as shillings per imperial quarter to facilitate comparison with English figures and averaged over seven-year periods to emphasise synoptic trends (Fig. 11.4).

Fiars were not struck for meat or wool and no standardised price series is available in Scotland for these products before 1818. A summary of the prices of Cheviot wethers averaged over seven-year periods is presented for 1821-1900 in Figure 11.5. Estimates based on English data and on miscellaneous local sources were made for 1750-1820 and may be considered approximate indicators of the Scottish trend.

Trends in the price of wool may be ascertained from a combination of English and Scottish data. Seven-year running means for 1720-96 and 1820-1900 are presented in Figure 11.6. Estimates for the period 1797-1819 are based on scattered references in local manuscripts and publications.

Trends The exceptionally high price of oats in the late 1640s is attributed to the Cromwellian war and years of occupation (1648-52). Mitchison (1965) believes that these indicate famine conditions, with a rise in prices of 100 per cent or more over previous norms. With the increasing commercialisation of agriculture at the time it is probable that, where the population and economy did not materially suffer under the occupation, cultivation expanded to supply the increased demand.

Similar conditions evidently prevailed in the 1690s (Fig. 11.4), with a 110 per cent rise in 1699 over previous norms. Yet the discussion in Chapter 10 has shown that this was a product of consecutive harvest failures, not of political upheaval or increased demand. An extension of cultivation would certainly not have occurred under such conditions which, indeed, contributed directly to the final and permanent abandonment of marginal arable. Thus the role of high prices in the movement of the cultivation limit is dependent on the circumstances that produce them.

Prices in the intervening years, 1650-90, fluctuated markedly. They were exceptionally low in the 1660s but reached a secondary peak in 1674 after a particularly severe winter and poor summer. It is interesting to note that both these phases were marked by abandonment of steadings and amalgamation of farms in the Borthwick area of Selkirkshire (Robson, personal communication, 1971). This may reflect a move away from cultivation to extensive stocking - a move which may represent a response to low cereal prices and climatic adversity. Sources for this period are less comprehensive for the Lammermuir area and it would be rash to assume that a parallel movement operated here. It would account, however, for the quantity of arable land abandoned in the study area at a similar time.

From 1700-50 cereal prices remained remarkably stable. The slow growth of demand was accommodated by increases in productivity and the lack of a rise in prices was apparently reflected in low rents and continuing retreat by the limit of cultivation. Over 1750-65, however, the value of both stock and cereals showed an increase (Figs. 11.4, 11.5), the product of a growing urban market and increased trade after the Union in 1707. Over the same period an extension of cultivation, including the establishment of new farms, occurred in the study area (supra p.184). The time seems to have been one of renewed optimism, reflected in the first general advance of farmland for 150 years.

Yet, after 1765, the rise in prices of wool, sheep and oats ceased and in the late 1770s oats and wool exhibited pronounced falls (Figs. 11.4, 11.5, 11.6). The contemporaneity of depressed prices and a spate of farm amalgamation is more than coincidental. The incidence of bankruptcy among tenants seems to have been high and there appear to have been explicit policies for the elimination of small farms on three estates in the study area (supra p.246). The decade was evidently characterised by recession throughout the agricultural economy, closely mirrored by retreat of the cultivation limit.

After the outbreak of war in 1793 prices rose steeply and, after a brief recession in 1802-3, resumed the climb to peaks in 1810 and 1815. Their impact on the pattern of farming in the study area has been considered in Chapter 8 and has been discussed elsewhere in a wider context (Thomas, 1963; Chambers and Mingay, 1966: 112-122; John, 1967). It will not, then, be considered in detail here, although relative changes in the value of cereals and stock deserve especial comment. It is evident from the graphs of prices that while the price of oats in 1809-15 was double the norm for 1770-90, that for sheep was triple and for wool was 250 per cent greater than the pre-war average. This explains the quantity of new land put down to turnips and grass rather than cereals which would have given the quicker return to capital.

Clearly the scale of such increases in the market value of produce was the major incentive to reclamation of moorland during the Napoleonic wars. Yet costs of production were also rising. Over Britain as a whole indices of wages rose from 87 to 100 over the war years (Mitchell and Deane, 1962: 191), and in south-east Scotland were reckoned to have almost doubled over 1779-1814 (Robertson, 1829: 400). Since production costs were generally higher in crop than in livestock farming, their increase tended to compound the difference in price rises and offer greater profits to the grazier than the arable farmer. Moreover, increased profits tended to be had more from the breeding than from the fattening of stock and thus encouraged the upland farmer, traditionally more active in breeding than feeding, to expand his activities more than the fatstock farmers around the periphery of the hill area (Farmer's Magazine, 1811: 353). Hence the spur to reclamation in the uplands was perhaps stronger than might initially have been judged.

It would be misleading to discount the quantity of new land that was 'catch cropped' with oats or bere for quick profit, but the place of roots and grasses was clearly an important factor in delaying the reversion of upland arable until the fall in stock prices after 1819. Yet, as the value of meat and wool had risen sharply in early war-time, so they fell more steeply than cereals after 1820 (Figs. 11.4, 11.5) and encouraged swift reversion, first to long ley and later to rough pasture.

The transience of the post-war depression in the region (supra p.257), particularly in comparison to the grain growing areas, may be attributable to the early recovery of stock prices in the late 1820s. They rose steadily throughout the following two decades, during which oats prices reached their lowest levels for more than fifty years, and encouraged an early start on tile-drainage and the re-intake of former arable. Moreover the stock prices prevailing in the 1870s approached those of the war-time peak, a far fuller recovery than that of cereals which were increasingly influenced by foreign imports. The probable increase of crops and grass in the study area between 1866 and 1880 may thus be attributed largely to the profitability of stock breeding before the onset of the Great Depression.

Changes in the value of land

If shifts of the cultivation limit were, particularly after 1790, largely a product of the changing profitability of upland cultivation, a convenient measure of their interaction may be sought in the changing value of upland arable land, in turn reflected as trends in average rents.

Over the thirty years prior to 1794 the rent for poor arable land in East Lothian had quadrupled, reflecting the changing balance between rising market prices and more stable costs of production (Hepburn, 1794: 128). Over the following fourteen years the rent for similar land seems to have almost doubled, paralleling the rise in prices, and in the following decade increased by a further 10 per cent (Kerr, 1809: Appx. p.56; GD 158/20: 10-11). Over the war years 1793-1815 the total rental of the estate of Marchmont rose by 93 per cent, an indication of the increased demand for land by prospective tenants (GD 158/20: 11); and on those estates which offered vacant farms to the highest bidder rents rose even more steeply.

The abatements of rent offered by estates after 1819 in (often unsuccessful) attempts to prevent the bankruptcy of their tenants is indicative of a sharp fall in profits (supra p.261). By 1823 average rents had fallen by one-quarter (Low, 1823) and, by 1836, by one-third (NSA: II, Berws: 244). It is evident from contemporary sources that such falls in the profitability of farming were the main cause of the abandonment of upland arable (supra p.257).

The availability of capital and credit

Yet the reclamation of moorland depended not only on the possibility of profit. It required the capital for heavy investments, particularly in labour to break up the new ground and in lime to bring it into a productive condition. In the latter part of the war this capital had been accumulated by a number of small tenant farmers through the recurring profits of the previous decade. But before 1800 large reclamation projects were, through necessity, financed by landowners (Smout, 1964); and it has been demonstrated earlier in this chapter that capital was readily available from the fortunes acquired through trade and in industry. The appearance of the merchant landowner was thus an important factor in the expansion of Scottish agriculture in the late eighteenth century owing to the resources at his immediate disposal and to the sources of credit with which he was more familiar than was the traditional landowner.

Access to credit also affected the extent of reclamation in the 1840s and 1850s. Under the Land Improvement Acts of 1846 and 1850 £2 million were set aside to provide loans for drainage, repayment being spread over 22 years (Symon, 1959: 405). Over one-third of the reclamation in Scotland in the mid-nineteenth century is likely to have been indebted to these loans. Without such encouragement the advance of cultivation in the study area at this time would certainly have been less pronounced.

INCREASED ACCESSIBILITY

Inadequate roads were a major restraint to the efficient movement of crops and lime (supra pp.239, 257). Before 1751 the roads were poorly maintained by statute labour and, even with provision for the erection of turnpikes after this date, there was little improvement in their condition (Farmer's Magazine, 1811: 350). The costs of carriage were considered to deter most farmers in the Lammermuirs from using lime in quantity and the delay in reclamation of the upland after the 1780s was certainly a product of continued inaccessibility (Farmer's Magazine, 1803). From the 1790s, however, through a combination of turnpikes and statute labour, the hill roads were improved and were reckoned the 'one great mean of beginning and accelerating the progress of agriculture' (Lowe, 1794: 99). It seems that the timing of advance of cultivation in the more remote parts of the study area was partly a function of these improvements.

Similar factors operated in the mid-nineteenth century when access to bone-dust, drainage tiles and Peruvian guano were of prime importance in determining the location of reclamation (NSA: II, Berws: 58). Reference has been made to the opening of the North British Railway in 1846 in encouraging the use of guano and promoting the extension of improved land (supra p.258). In 1869 such improvements were stimulated by the substitution of turnpikes by a rating system for the maintenance of roads.

It is interesting to note that a severe restraint to the maintenance of improved land or the reclamation of moorland at the present time is poor access to the interior of the study area. Several of the tracks that were once frequently used for crossing the hills were not adopted by the county councils and are now unusable.

POPULATION CHANGE

Since about 1800 the population of the study area has been more the product of the quantity of cultivation than a factor behind it. At an earlier period, however, it seems that changes in population may have wrought changes in the limit of cultivation.

There is certainly evidence from the twelfth and thirteenth centuries for pressure on available farm land and the consequent incentive for 'a steady process of winning new arable land from waste' (Barrow, 1962: 127). Indeed, it is not easy to account for the increasing demand for ploughland evident in the study area in any other way. Conversely, if estimates of a one-third fall in population over 1349-1401 are correct, the change in balance between land and labour after the Black Death would have been sufficient to promote the contraction of tillage and abandonment of settlement, particularly on marginal land. Certainly the loss of population at this time has been considered an important factor behind the desertion of settlement and land elsewhere in Britain in the mid-fourteenth century, and the evidence is sufficiently comprehensive for a correlation between abandoned land and population fall to be firmly established (Beresford and St Joseph, 1958: 92; Beresford and Hurst, 1971: 8; Beresford, 1969: 55; Orme, 1970: 113). In few cases was it the major, and in none was it the only, cause (Beresford, 1951), but it is suggested that in the study area it provided an immediate stimulus for abandonment in an environment that, through economic and climatic decline, had become especially sensitive to any changes that touched upon its viability for settlement and cultivation.

Over 1790-1810 a minor fall in population (illustrated in Fig. 11.7) appears to have resulted from the amalgamation of farms and removal of cot-houses (OSA: I: 123, 358; II: 358). The consequent shortage of labour in the war years increased the rate of farm wages and encouraged the adoption of labour-saving machinery. From 1810 the trend of population mirrors the changing fortunes of agriculture (Fig. 11.7).

THE EXPLANATION FOR CHANGE : SUMMARY

The previous three chapters have attempted to single out those factors which played the major role in dictating the timing, location and nature of changes in the extent of upland cultivation.

The main physical factors which determine the synoptic pattern of the cultivation limit appear to be summer warmth, summer wetness and exposure. The nature in which these restraints operate points to those forces which promoted the reaction of the moorland edge to such restraints.

A distinction has been made between those forces which operate over the long-term and those over the short-term. The suggestion is that, from the fourteenth to the early eighteenth century, a deteriorating climatic environment constituted the underlying reason for widespread retreat by the limit of cultivation. It often dictated the location of land abandonment for it was the highest and most exposed land that tended toward increasing climatic sub-marginality. Yet the timing of abandonment was dependent on short-term forces to which sub-marginal land was especially sensitive. It is evident that, before 1750, political upheavals, population falls, changes in the pattern of land ownership, or consecutive harvest failures were the immediate stimuli of intake or abandonment.

From the mid-eighteenth century, however, upland agriculture was largely motivated by commercial considerations. Changes in the profitability of cultivation - the difference between market prices and the costs of production - tended to determine the pace of reclamation or abandonment. The incentive of profit inspired changes to the pattern of land ownership and tenure which were, in turn, direct causes of changes in the extent of cultivation. It also encouraged innovations in technology, of which the most important were the introduction of improved drainage, of liming and new crops. A synthesis of the new technology comprised a change in farming practice which offered substantial increases in productivity both in land and labour. Changes in productivity and changes in prices thus constituted the two main forces behind movement of the cultivation limit after 1750.

PART V

CONCLUSION

CHAPTER 12

CONCLUSIONS

In the following pages the techniques adopted in the mapping and dating of changes in the limit of cultivation are assessed, the trends of reclamation and reversion are summarised, and an interpretation is made of movements by the limit. Finally, the implications of these conclusions are discussed.

ASSESSMENT OF THE METHODOLOGY

The mapping of abandoned land from aerial photographs was controlled by interpretation keys that were constructed after reconnaissance of part of the study area and of two other regions of upland in Scotland. These keys reduced errors due to intuitive interpretation and ensure that the criteria for interpretation are valid for most other upland areas in Britain. The study of a duplicate coverage of aerial photographs, combined with two series of field checks on interpretation and a final set of field traverses, ensured that all interpretation was confirmed or rejected with certainty. It is suggested that this procedure might be applied with confidence to the mapping of similar, though more extensive, areas of abandonment in the Scottish Highlands. A check on the survey in the study area suggested that the mapping of cultivation ridges in the moorland core is accurate to within ±250 ha (or ±5 per cent). The results of the survey indicated that 4,890 ha (11.1 per cent) of the moorland core of the study area were under cultivation before 1860.

A chronology of reclamation and abandonment of this and other land in the study area has been constructed by reference to a number of sources. The use of a series of county maps enabled the dating of 62 per cent of all initial reclamation in the region, and an analysis of the morphology of cultivation ridges allowed a further 16 per cent to be assigned with confidence to periods preceding or following the end of the eighteenth century.

The dating of abandonment was less comprehensive. Only 21 per cent could be assigned to a twenty- or thirty-year period, but all the remainder could be placed in pre- or post-improvement categories according to the morphology of the ridges. Precision in the dating of specific changes in land use was gained by analysis of selected miscellaneous sources. A detailed chronology for the majority of the changes was extrapolated from these sources across a framework established by the examination of county maps.

SYNOPSIS OF TRENDS IN RECLAMATION AND REVERSION

The date and distribution of primary reclamation, permanent abandonment and temporary reversion of cultivation in the study area over the period 1600-1970 are summarised in Figures 12.1 to 12.4 and in Table 12.1. They have been prepared from the synthesis of evidence from Ordnance Survey and county maps, from aerial photographs and a survey of the relict landscape, and from miscellaneous records.

Table 12.1

Extent of reclamation and reversion, 1600-1970

	reclamation (ha)		reversion (ha)	
	initial	secondary	permanent	temporary
1600-1750	4,400	100*	225	2,220*
1750-1770	1,150	1,000*	80	2,500*
1770-1800	1,140	2,000*	160	500*
1800-1825	2,940	1,500*	240	1,500*
1825-1860	1,300	300*	590	2,500*
	(plus undated: 22,170 pre-1860)			
1860-1896	3,620	2,140	446	339
1896-1905	830	1,850	326	234
1905-1923	570	1,070	1,427	273
1923-1932	0	20	2,694	1,246
1932-1953	70	2,310	795	645
1953-1970	535	1,625	860	-
	5,625	9,015	6,548	2,737

*estimates

Primary reclamation

Figure 12.1 illustrates the stages of advance by cultivation toward the moorland core of the Lammermuir Hills. This advance exhibits some distinct temporal and regional trends.

1) During the seventeenth and early eighteenth centuries primary reclamation appears to have exceeded 4,400 ha (Table 12.1). Such land was located predominantly on the Upper Merse, Coldingham Moor and parts of the Lothian platform - areas which evidently had been avoided by medieval colonisation, possibly owing to inadequate slope and acid soils. Indeed, these areas are broadly coincident with the 'debatable land' noted by Ogilvie (1944) as marginal to contemporary agriculture. It thus seems that their marginality is manifested throughout the history of their land use.

Most of the reclamation between 1600 and 1750 occurred in 1600-55 and was associated with the creation of entirely new farms rather than the expansion of existing ones.

2) Between 1750 and 1770, but probably in the decade 1760-70, more than 1,150 ha of hill land were taken in, the equivalent of 2 per cent of existing cultivation; and once more the intakes were concentrated on the 'debatable land'. The process of absorbing outliers of rough pasture thus continued but, although advance began to occur at this time on the Stow Uplands, there is evidence of improvement at only four sites above 230 m O.D. and at only two above 300 m O.D. Only eight new farms, or 6 per cent of all those created in the period, were established at or above the moorland core. The advance seems to have been directed more to the basin peats than to the upland moors.

3) In the following decade, 1770-80, this sectoral advance on the platforms flanking the Lammermuir Hills apparently ceased, but was renewed after 1780 and accelerated after 1790. Firm evidence is available for the primary reclamation of 1,140 ha (Table 12.1) but indirect sources suggest that this figure seriously underestimates the total intake. The implication is that much of the farmland to which a firm date of intake cannot be ascribed was improved after 1790. In addition, there occurred an extensive secondary intake of land that had reverted to moor over 1750-70.

4) From 1800 to 1816 this advance continued. More than 3,000 ha of moor were reclaimed in addition to the re-intake of 1,500 ha of former arable. Not only was the pace of advance radically altered, however, but its direction was reoriented. Reclamation was no longer limited to traditional moorland outliers but was focussed also on hill pasture. Figure 12.1 illustrates the widespread primary intake of high-level moorland in the Duns and Stow Uplands, above the south-eastern valleys, and above the northern scarp. Moreover, there is evidence for the extensive secondary intake of medieval farmland that had lain uncultivated for more than two centuries.

It is surprising that, in spite of the traditionally ephemeral nature of war-time prices which contributed to this advance, most of the improvement may be linked with the creation of new farms. Over 1770-1800 one-third of the new farms was associated with reclamation, and over 1800-25 the figure was more than one-half; thirteen of these farms were linked with cultivation within the moorland core. The implication is that much of the intake was planned at the time as a permanent advance of improvement and was not wholly a response to short-term rise of prices. Innovation in liming, drainage and varieties of crops appears to have been a major incentive for upward advance.

5) The advance ceased after 1816 but was renewed in 1823 and accelerated from 1835. Over the following twenty years it is probable that more than 1,300 ha of moor were brought under the plough, largely on the divided commonties of Coldingham and Chirnside, and in traditional sectors of post-medieval intake such as the Upper Merse and Stow Uplands.

6) With a knowledge of the distribution of farmland before 1860 it is possible to distinguish between primary and secondary intake over the period 1860-1970, and thus to assess the quantity and direction of advance by the limit of cultivation. The distribution of primary reclamation between the dates of survey for the five editions of Ordnance Survey maps used in this study is illustrated in Figure 12.2. Figures for primary and secondary intake are summarised in Table 12.1.

It is evident that more than two-thirds of the reclamation indicated by the Ordnance Survey over 1860-96 represented the initial intake of virgin moor. This was concentrated, first, on Coldingham and Quixwood Moors and the north-east Lammermuirs which had been recently released for improvement by division of commonty and, secondly, on the Stow Uplands. A comparison of Figures 3.2 and 12.2 will reveal that, conversely, the secondary intake of abandoned farmland centred on the south-eastern valleys that had been characterised by almost continued reversion since the late medieval period.

. After 1880 the rate of primary reclamation was severely reduced and, although there was some increase at the turn of the century, it accounted for only one-third of the total intake of land between 1896 and 1923. Moreover, between 1932 and 1953 almost all the advance by farmland was on to areas that had once been cultivated and largely abandoned in the 1920s. The only extensive intake of new land in the region has occurred since 1950.

The major phases of advance may, then, be defined as follows: 1600-55, 1760-70, 1790-1816, 1858-77, 1900-20, 1950-70. With the exception of the Napoleonic period, during which both primary and secondary intake occurred at high level in the central Lammermuirs, reclamation was directed toward the Stow Uplands and to outliers of moor in the south and east.

Permanent and temporary abandonment

The survey has revealed that 4,890 ha, or 11 per cent of the moorland core of the study area, was formerly cultivated but was permanently abandoned before 1860. A further 6,550 ha reverted to permanent moor after 1860. The distribution and date of this abandonment is illustrated in Figure 12.3.

Temporary abandonment before 1860 is less readily mapped and dated, but about one-half may be tentatively assigned to one of two phases, 1600-1750 or 1750-1860. The distribution of this land is illustrated in Figure 12.4. However, estimates of the quantity of reversion which occurred in certain periods may be drawn from a synthesis of evidence from miscellaneous records. These are presented in Table 12.1.

The spatial and chronological trends evident in the abandonment of cultivation may be summarised as follows:

1) Between 1660 and 1750, and in particular over the period 1680-1700, permanent abandonment of farmland was widespread at the most remote upland sites. There is evidence for the permanent reversion of 225 ha in upper Lauderdale, and on the slopes above the south-eastern valleys, at elevations generally exceeding 300 m O.D. More than 2,220 ha of cultivation reverted to moor over the same period, although this was later reclaimed.

Total abandonment thus amounted to 4.6 per cent of the farmed area in 1600 and, since most occurred at the upper margins of improvement, it appears that cultivation exhibited a marked retreat from the levels it had achieved in the early medieval period.

2) Over the decade 1750-60 it is likely that the pace of retreat continued unchecked around remote farms in the south-eastern valleys. More than 80 ha of permanent reversion may have been associated with the abandonment of seven steadings and it is estimated that a further 2,500 ha fell back to moor until their secondary intake during the Napoleonic Wars.

3) In the following decade permanent reversion was reduced in response to slowly rising prices, but was encouraged over a short period between 1770 and 1780 by the widespread amalgamation of farms in the region. About 160 ha of permanent abandonment have been linked with the disappearance of nine steadings. The extent of ephemeral reversion is likely to have been limited and, in common with long-term reversion, did not occur

specifically in areas characterised by earlier retreat. Farm amalgamation appears to have contributed to a scattered distribution across the breadth of the study area (Fig. 12.4).

4) Reversion continued to be restricted after the collapse in cereal prices in 1813. It was, however, widespread from 1819 to 1823 and, to a reduced extent, to 1835. To this period may be dated most of the 830 ha and 22 steadings known to have been permanently abandoned between 1800 and 1860. Much of this abandonment was concentrated in the south-eastern valleys and the Upper Merse, the first reflecting the relinquishment of long-established remote farmland and the latter representing abandonment of areas brought into cultivation during the war years.

5) An examination of the distribution of permanent abandonment after 1860 reveals a continuing concentration in areas of earlier retreat. Comparison of Figure 12.3 with the patterns of reversion in Figures 3.2-3.7 illustrates that a greater part of reversion in the Stow Uplands, Lauderdale and on the Lothian platform during most of the inter-survey periods was soon reclaimed. By contrast, farmland which fell down to rough pasture in the south-eastern valleys and southern Lammermuirs was less frequently brought back into cultivation.

It seems, therefore, that, throughout the period 1600-1970, but with the exception of the decade 1770-80, permanent abandonment most frequently occurred at high levels, particularly in the upper valleys of the Whiteadder Water. These sites were generally settled in the early medieval period, and are characterised by an early history of successful cultivation. The main phases of their abandonment appear to have been: 1660-1750 (particularly 1680-1700), 1770-80, 1819-23, 1905-30.

1819-23

INTERPRETED CHANGES IN THE LIMIT OF CULTIVATION

This synopsis of intake and reversion is drawn from data that relate to large proportions of the total change in land use but are, nevertheless, not comprehensive. It has been possible, however, to assign the remaining undated areas to broad periods in the chronology and to infer the approximate date of several changes from indirect evidence in a variety of sources.

However, the extrapolation of trends and patterns, supported by broad inferences of associated change, permits an interpretation of synoptic movements by the limit of cultivation before 1860 across the entire study area. Limits of cultivation have thus been reconstructed for five periods: 1600, 1750, 1770, 1800 and 1825. They are illustrated in Figures 12.5-12.8 respectively.

These reconstructions provide a picture of change at the margin of cultivation over 250 years up to the middle of the nineteenth century, after which an accurate record is available in the series of Ordnance Survey maps (Figs. 3.2-3.7). They should be treated with reservation since they are based upon an extrapolation of limited evidence, but they are considered to be sound at the synoptic level. Over large areas they are, of course, accurate in their detail, the levels and areas of accuracy tending to increase toward the end of the chronology.

An examination of Figures 12.5-12.8 reveals regional trends that were noted to be present at the local level in the patterns of reclamation and reversion. It is evident that in the early seventeenth century the limit of cultivation varied remarkably in elevation (Fig. 12.5). There existed large areas of improved land above 300 m O.D. in Lauderdale and the south-eastern valleys. At some sites cultivation exceeded 410 m O.D. It is clear that many of these were taken from the moor in the early medieval period and thus represented some of the most longstanding settlement in the region. It appears, however, that several of these settlements were in difficulty and, indeed, that some had already been abandoned by 1600 (Appx. I.1).

In contrast, however, was the existence of large moorland outliers at Quixwood and Coldingham, on the Upper Merse, and in the Stow Uplands. These areas had evidently been avoided by settlement and agriculture throughout the medieval era, presumably owing to the attraction of better land elsewhere. The early history of land use thus bears out the point made by Ogilvie (1944) that much of the 'higher lowland peneplain' in southern Scotland is marginal to cultivation owing to the combined influence of elevation and inadequate slope. To this might be added the restraint of exposure in coastal areas.

The history of change in the limit of cultivation after 1600 is characterised by a process of rationalisation of the early pattern, that is, by a retreat from the highest levels reclaimed in the medieval era and by an advance into the lower outliers of moorland. The stages in the reclamation of the Stow Uplands, the Upper Merse, and of Quixwood and Coldingham Moors are illustrated in Figures 12.5-12.8. They represent the major adjustments to the limit of cultivation.

Also apparent, however, is the abandonment of farmland, first, at the head of Lauderdale and the tributaries of the Whiteadder Water and, secondly, in remote 'islands' of improvement on Greenlaw Moor. This represented the removal of irregularities in the limit of cultivation where the margins of the farmed area had been over-extended in the Middle Ages.

It would be wrong, then, to view the chronology of change as one of straight forward advance and retreat analogous to the rise and ebb of a tide, with a high-water mark that is readily defined. The location of a maximum extent of cultivation would vary greatly according to its definition.

It seems that the greatest elevation of long-term cultivation was 440 m O.D. and was attained in the medieval period but relinquished before 1700. The latest date of extensive high-level farming might, however, be placed in the late seventeenth century or before the temporary reversion of cultivation after 1750. A secondary peak occurred in about 1816, at the height of the Napoleonic expansion; this approached but certainly did not exceed levels existing in the early seventeenth century.

On the other hand, the greatest extent of improved land throughout the study area was attained after 1900, probably in the war years 1914-18. It was achieved, however, as much by the intake of the lower moors as by an upward advance of improvement. The average height of the moorland edge was higher than it had ever been, but the extreme elevations of medieval arable land were never approached.

Associated changes in settlement

It is convenient at this point to summarise those changes in settlement that have been associated with the advance and retreat of cultivation.

The study of aerial photographs and county maps has revealed the locations of 251 steadings in the study area that were abandoned before 1860. A further 37 former settlements were identified from early charters as abandoned between 1600 and 1750, and 104 were noted to disappear from Ordnance Survey maps. It thus seems that about 36 per cent of the total number of the 1,074 farm steadings which once existed in the study area now lie abandoned, many of them with little trace on the present landscape.

In the present study reference has been made to former settlement only as an aid to the mapping and dating of former cultivation. However, it is clear from the magnitude of desertion of settlement that this would reward closer study elsewhere in upland Scotland.

SIGNIFICANCE OF THE RESULTS

Comparison with earlier studies

Owing to the complex nature of change in the study area, the results of the survey do not bear straightforward comparison with the conclusions of studies conducted in the western Highlands. These have pointed to a peak of cultivation occurring at about 1769 in Skye (MacSween, 1959a: 45) and in the 1770s in Ardnamurchan, Argyllshire (Gailey, 1961: 152). Here, it seems, the limits of advance are more easily defined than in south-east Scotland. The present study has indicated that in the Lammermuir Hills the highest levels of improvement were achieved in the Middle Ages. Most of this land remained improved until the end of the seventeenth century and it is at this date that a peak of cultivation is most readily drawn.

However, extensive reversion after 1750 is contemporary with that in the west.

Moreover, the evidence for a Napoleonic advance in the south-east correlates broadly with reports of the expansion of cultivation in the south-west Highlands (Gailey, 1963). This is surprising in view of the contrast in degree of market-orientation that characterised agriculture in different parts of Scotland due to varying distance from external sources of demand. The scarcity of studies on agricultural change in Scótland precludes further comparison with other regions. In particular, confirmation of the conclusions concerning the elevation of medieval improvement in Scotland must await future research. They are, however, paralleled by observations of similar peaks of settlement in some English uplands (Beresford, 1969).

Implications for the study of Scottish history

This survey has contributed to an understanding of the extent of abandoned land in upland Scotland. It has revealed that 11 per cent of a moorland core, which is recorded as remaining unimproved over the last century, was cultivated over lengthy periods before 1860. Previous estimates of abandoned farmland in Scotland have often only considered the areas that reverted to rough pasture during the depressions of the 1880s and 1920s. It was not widely realised that the extent of this recent abandonment may be almost equalled by a much earlier retreat of the limits of cultivation.

It would be unwise to assume, however, that abandonment in the Highlands was of the same relative extent as that in south-east Scotland.

Surveys conducted along similar lines to the present study would first need to be implemented in selected areas to assess the level of regional contrast. But there is no reason to suppose that the trends apparent in the Lammermuirs are not indicative of developments in the Pentland and Moorfoot Hills that lie to the west of the study area, and in the Cheviot Hills south of the Merse. Indeed, reference has been made to evidence for widespread abandonment of land in Selkirkshire that is contemporary with retreat in Berwickshire and East Lothian.

It remains for the student of social or economic history to judge the results of this survey in the light of known national trends and to draw inferences from the foregoing conclusions. However, some implications that may reward further examination are summarised below.

1) The study has revealed a rapid advance by cultivation in the early medieval era to peaks that occurred at a similar time in some English uplands. This may point to a higher degree of prosperity in agriculture, certainly in the south-east of Scotland and probably in other areas of monastic settlement, than has generally been recognised.

2) The extensive abandonment of high farmland in the middle and late seventeenth century may reflect the marked effects of, first, a slackening of population pressure owing to epidemics of typhus and, secondly, a general fall in prices after 1655. The impact of these developments on the rural economy deserves reassessment.

3) The reversion of land after 1760 has been attributed to farm amalgamation which was promoted by increased commercialisation of upland agriculture in the south-east. This appears to correlate with increased

prosperity throughout the Scottish economy and might be used as a yardstick for assessing regional variations in the stimulus given to the rural economy by the union with England.

4) The extent of the advance by cultivation over the war years, 1793-1815, is indicative of levels of response to market forces. It suggests that upland farms in the south-east were more commercialised than is otherwise apparent.

Furthermore, the survey has assessed the role of two factors in promoting change in the structure of farming: technical innovation and climatic deterioration. The following sections summarise the conclusions drawn from this assessment.

The role of technical innovation

It was estimated by a contemporary writer that total crop production in East Lothian had doubled between 1765 and 1827 (Robertson, 1829: 383). Over this period reclamation was widespread at the edge of cultivation, about one-tenth of the moorland in the hills being brought under the plough; it is also clear that scattered patches of rough pasture throughout the lowlands were being absorbed at the same time. Some of the scale of this expansion of cultivation has been attributed, first, to the acceptance of liming as an integral part of the farming system, secondly, to the provision of shelter and, finally, to the adoption of new crops or varieties of crops that tolerated lower levels of warmth, together with more moist and more exposed conditions during the growing season. These innovations in agriculture encouraged the intake of high land that had been unsuited to the husbandry of traditional crops.

But the extension of cropping accounts for only a small proportion of the increase in total production most of which was the result of an increase in productivity per hectare. A study of the morphology of cultivation ridges has revealed that their levelling in the late eighteenth century resulted in a halving of the average ridge:furrow ratio and a consequent reduction of the unproductive area of furrow from one-quarter to less than one-sixth of the ploughed land. It is estimated that this improvement led to a 13 per cent increase in productivity per hectare. This stresses the importance to be attached to the introduction of Small's swing-plough, without which the improvement of ridges might not have been effected.

Further increases in productivity arose from the move to perennial cultivation of all improved land in contrast to irregular cropping of outfield that averaged one year in two under the traditional infield-outfield system. Under the assumption that outfield land comprised about two-thirds of the farmed area, it seems likely that the area cropped at any one time increased by one-half in the late eighteenth century.

Moreover the introduction of improved rotations maintained the base status of soils at higher levels and led to greater returns to seed. Consequently yields per hectare of improved land were about 40 per cent greater than those obtained under the outfield system.

It is clear, then, that the retreat of cultivation was in part a response to increased productivity unmatched by growing demand. Much of the increase in productivity derived from the adoption of improvement in drainage, in liming and in crop type, encouraged by the increased profits that would stem from their use. Technical innovation was thus promoted indirectly by high prices but its consequences often ran contrary to the hypothesis that advance of cultivation reflected rising prosperity in agriculture.

The role of climatic change

Discussion of the role of changes in climate in promoting movement of the cultivation limit has been presented in detail since it is a factor that has been given scant consideration in previous studies.

Analysis of the physiological requirements of oats has indicated that their cultivation in the marginal uplands of south-east Scotland is particularly sensitive to three climatic factors: summer warmth, summer wetness and exposure. This sensitivity is readily appreciated when it is noted that the frequency of harvest failure increases exponentially with falling summer warmth.

Absolute climatic limits to the cultivation of oats have been constructed from parameters of these factors and drawn for the study area, and a comparison with evidence for the location of former arable land has revealed that at a number of sites cropping was practised well above these limits over lengthy periods and with apparent success in the Middle Ages.

When known changes in mean temperature and rainfall are resolved into these parameters, however, it is clear that the scale of deterioration of growth potential at elevation since the Middle Ages has been substantial. Land over 300 m O.D., which had enjoyed an average frequency of crop failure of less than 1 in 20 in the early medieval period, became marginal to subsistence cereal cropping by the mid-fourteenth century, sub-marginal by the mid-fifteenth century and by c. 1660-80 was offering only an even chance of a successful harvest.

A downward movement by critical levels of the parameters exhibits a close coincidence with the distribution of contemporary land abandonment, pointing to a conclusion that retreat by the limit of cultivation in the late medieval period was, at least in part, a function of deteriorating climate. It is suggested that this causal relationship operated through the promotion of increasing marginality of high-level arable farming which as a result became sensitive to a more immediate stimulus for abandonment. Had this long-term loss of growth potential not occurred, neither the scale nor the permanence of abandonment would have been so marked.

The implication of this argument for the third hypothesis tested in this study is that, since the assumption of a static physical background is no longer tenable, movement by the limit of cultivation is not always an accurate indicator of regional economic change.

Prospects for reclamation

Yet all except the highest and most exposed sites of former cultivation now lie well below critical levels of climatic restraint on farming. There are two reasons for this. First, it is evident that a steady amelioration of climate has returned the potential for crop growth to the levels averaged during the late Middle Ages. Secondly, a majority of the crops now grown at the upper margin of cultivation, such as turnips and varieties of sown grass, require considerably lower temperatures than oats for germination and have a shorter vegetative period. New strains of oats have similar advantages over those commonly sown in the past and, moreover, are frequently cut green well before the traditional period of harvest. There are, therefore, no absolute climatic restraints on the future improvement of abandoned land, although it is true, of course, that the same increase in severity of restraint operates with increasing elevation.

In 1970 there were present in the study area 4,890 ha of moorland which were cultivated before 1860 and a further 6,550 ha that have reverted to rough pasture in the following century. This area presently constitutes 20.0 per cent of the total rough pasture in the region.

There are several reasons for believing that these sites of former arable have inherent qualities for improvement that are absent in virgin moorland:

1) Land that has been cultivated in levelled ridges, and abandoned after 1800, is likely to be entirely free of stones. Their costly removal is thus avoided. Land that was abandoned before 1800 and lies in high-backed ridges has been cleared of some stones, the remainder lying beneath surface vegetation in the original furrows. A number of farmers in the study area have speeded the clearance of stones by locating the furrows and removing the largest obstructions before the first ploughing.

2) The base status of soils cultivated in the past tends to be higher than those of virgin moor, first, because of the legacy of former husbandry, particularly the addition of lime and, secondly, because the continued existence of cultivation ridges has maintained more free drainage and has reduced leaching. The frequent presence of distinct patterns of vegetation, particularly of Agrostis tenuis and Festuca ovina, on abandoned ridges reflects this low acidity and improved drainage.

3) The presence of disturbed mineral horizons below shallow surface root mats on areas which were formerly cultivated reduces the quantity of raw humus that must be ploughed and harrowed.

4) Finally, where there is evidence of long-term and successful cultivation in the past, the implication is that the site had inherent advantages for improvement that it may continue to offer. The converse, of course, may also be true: that sites with a record of ephemeral and unsuccessful reclamation do not have qualities that are apparent on initial observation, and thus the farmer seeking to extend his improved land should avoid these areas.

The extent of reclamation in Scotland at the present has been emphasised in the introductory chapter. This reclamation is expected to continue over the next year (supra p. 5). Thereafter the membership of the United Kingdom in the European Economic Community is likely to alter the incentive for improvement, although the direction and degree of its effects are at present uncertain. It is clear, however, that a knowledge of the location and nature of former cultivation is a valuable asset to those planning the extension of improved land. This has been indicated by the interest expressed by farmers in south-east Scotland in the results of the mapping for this study.

SUGGESTIONS FOR FURTHER WORK

A number of suggestions have been made concerning those issues that may reward further research. These appear to fall into two categories.

First, the methodology established in the present study might be directed toward a practical end on a large scale. It is clear that the quantity of abandoned land in the study area may reflect similar quantities elsewhere. This could be tested by a survey of regions of comparable size in, for example, south-west Scotland and the Scottish Highlands. At the same time it appears that closer attention should be given to the value of abandoned land for future reclamation. If abandoned land has substantial inherent advantages over virgin moor _vis a vis_ improvement, and if abandonment is found to be widespread, then consideration might be given to its mapping and reclamation on a large scale.

Secondly, one may point to issues of more academic interest that deserve further study. It is important that a chronology of change should be constructed for other upland areas so that the implications of the present study may be more fully assessed. In particular it would be valuable to know whether the scale of former cultivation and settlement was as widespread elsewhere as it was in south-east Scotland. The procedures developed in this study for mapping the relict landscape should facilitate future surveys. Finally, it appears that the role of climatic change in the history of marginal areas might be given more attention than it has previously been afforded; this is not to advocate a return to historical determinism but to urge the reconsideration of assumptions of an unchanging physical environment in the history of early settlement.

VERIFICATION OF THE HYPOTHESES

This survey has enabled three hypotheses which were proposed in the introductory chapter to be tested. Some conclusions are presented below:

1 (Hypothesis verified) It is evident that abandoned farmland is extensive in the study area. It comprises 20 per cent of the rough pasture in the region.

2 (Hypothesis verified) It is evident that much of this land represents former long-term, not ephemeral, cultivation and its abandonment is therefore important in terms of the economic history of the region and its present land capability.

3 (Hypothesis refuted) It is evident that changes in the limit of cultivation are in part the product of environmental change or of social and political developments. They are often determined by technical innovation in cultivation. They are therefore not accurate indicators of changing prosperity in agriculture.